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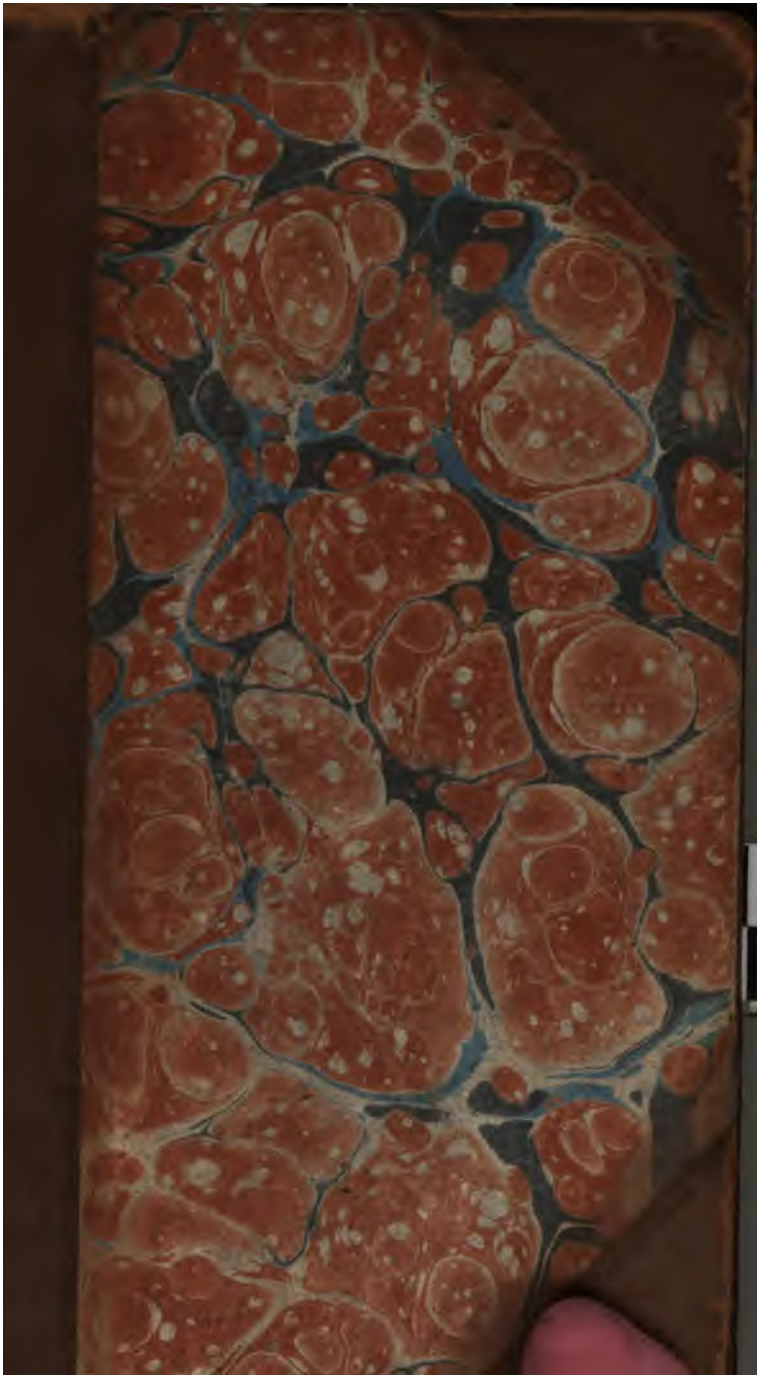

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CHEMICAL DIAGRAMS.

LONDON.
PRINTED BY MILLS, JOWETT, AND MILLS,
Bolt Court, Fleet Street.

CHEMICAL DIAGRAMS,

ACCOMPANIED WITH A

CONCISE DESCRIPTION OF EACH DECOMPOSITION:

THE

VEGETABLE ALKALIES,

THE URINE AND URINARY CALCULI.

TABLES OF CHEMICAL EQUIVALENTS, &c.

INTENDED TO

FACILITATE THE PROGRESS OF THE MEDICAL STUDENT.

By ALEXANDER LEE, A. M., Surgeon,

EDITOR AND TRANSLATOR OF CELSUS.

LONDON:

PUBLISHED BY E. COX, ST. THOMAS'S-STREET, BOROUGH

MDCCCXXXIII.

122.

TO

THE GENTLEMEN

ATTENDING

THE BOROUGH MEDICAL SCHOOLS

This little Work

IS MOST RESPECTFULLY ADDRESSED,

ITH A SINCERE HOPE OF ITS BEING OF ESSENTIAL SERVICE
TO THEM.

A. L.

PREFACE.

In submitting the present little treatise to the notice of Medical Students, it is incumbent on me to give an outline of the work. In doing so, however, let it be understood that I claim nothing more than having collected the most important decompositions from every accessible source, and arranged each in the form of a Diagram, together with its letter-press description, in as clear and concise a manner as I possibly could.

As to the general arrangement of the work, I have divided it, first, into *inorganic* and *organic* chemistry; the former of these is subdivided into *parts*, on account of its great extent: I have also numbered the decompositions throughout, to allow of a greater facility in reference: lastly, several useful tables will be found at the end of the book, of which more hereafter.

The first part contains the decompositions which occur during the formation of those bodies termed the *supporters of combustion*, or the electro-negative bodies; viz. oxygen, chlorine, iodine, bromine, and fluorine. The second contains the decompositions which occur during the combination of the five preceding bodies, to form new compounds.

The third part is allotted to another class, called the *simple non-metallic combustibles*, or the *electro*-positive bodies, and the compounds formed by their union with the first class.

In the fourth part, the decompositions occurring during the combination of the simple non-metallic combustibles, one with another, are described.

The metals and their compounds, with all the preceding bodies, are treated of in the fifth. And there I have only described decompositions connected with the most important metals; omitting several, first, because they are of little use; and, secondly, because all the decompositions connected with them are quite analogous to those already described.

The sixth part is allotted to *organic chemistry*, in which vegetables constitute by far the largest portion of the division; the animal chemistry containing few decompo-

sitions of any importance to the medical pupil; and of these nearly all are decompositions of the simplest possible kind.

This concludes that part of the work which may with propriety be called THE CHEMICAL DIAGRAMS. I may observe, that I have, with very few exceptions, affixed the atomic proportions to each diagram; and where remarks appeared necessary, I have generally affixed them in the form of a note.

To render this work as useful as possible, I have affixed several tables; the two first of which are tables of chemical equivalents. In the former of these the substances are arranged systematically, being marshalled into divisions and subdivisions, according to the analogy of composition and general characters which one body bears to another: in the latter, the bodies are arranged alphabetically; in which case it frequently happens that bodies, having similar chemical constitution and general characters, are distributed here and there, in what I consider a very unseemly and unnatural manner.

There is another table, which shows the volumes in which gaseous bodies combine to form new compounds, and the resulting volumes, for which I am indebted to Dr. Henry's Elements of Chemistry.

I have also given the weight and specific gravity of the principal gaseous bodies in a tabular form.

The specific gravity of the different metals is the subject of the next table.

Then tabular forms of the actual quantity for different specific gravities of ammonia, sulphuric, nitric, and muriatic acids.

At the end of the book will be found rules for the comparison of the different thermometers: and also a table, showing the corresponding degrees on Fahrenheit's, Reaumur's, and Celsius's, from the boiling point of water to the freezing point of mercury.

And lastly, at the suggestion of a friend, I have given a description of the chemical characters of the vegetable alkalies and of urine; both of which are incorporated in the body of the work.

Having now given a general outline of the work, it only remains for me to say a very few words on its use. Let it not be supposed that it is intended to supersede the valuable works of Drs. Henry and Turner,—such an idea was never entertained by me. Its proper use is, first, in the lecture-room, to enable the pupil more readily to understand the changes which the lecturer is describing, either verbally or by diagram. In furtherance of this

object it might be as well to have the book interleaved, which would enable him to write out a description of each body, by which means the subject of the lecture would be more permanently impressed on his mind. And when the pupil, with his midnight lamp, is busily engaged in perusing some abstruse chemical work, this little book will, I trust, enable him to unravel many decompositions which might otherwise appear almost unintelligible.

With this assurance, I now commit this little work to the kind consideration of the Medical Pupil, with a sincere but confident hope, that it will be of some service to him while engaged in the ardent pursuit of chemical knowledge.

A. L.

THREE-CROWN SQUARE,
BOROUGH,
August 16, 1833.

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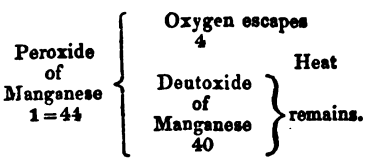
CHEMICAL DIAGRAMS.

PART I.

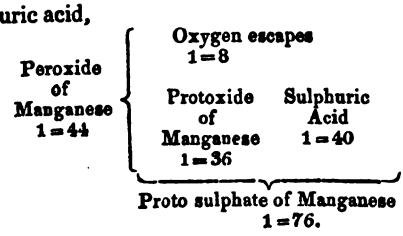
Decompositions which occur during the formation of Oxygen, Chlorine, Iodine, Bromine, and Fluorine.

OXYGEN, ATOMIC WEIGHT 8.

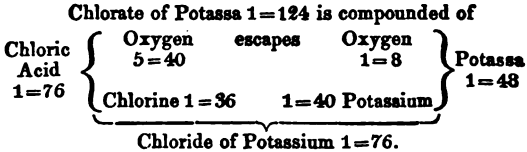
1. When peroxide of manganese is heated *per se*, 44 parts by weight of peroxide yield 4 of oxygen and 40 of deutoxide of manganese.



2. When peroxide of manganese and sulphuric acid are heated together, 44 parts by weight of peroxide are resolved into 8 of oxygen which escapes, and 36 of protoxide of manganese, which remains in combination with the sulphuric acid,



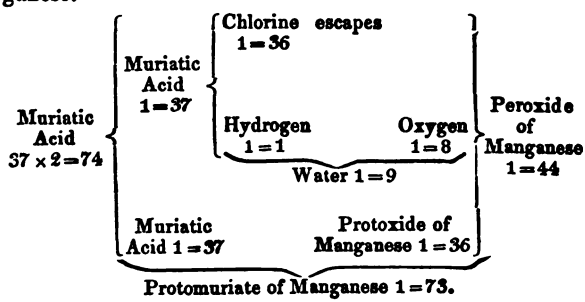
3. Chlorate of potassa at a high temperature is entirely resolved into oxygen and chloride of potassium in the following manner:—



CHLORINE, ATOMIC WEIGHT 36.

First Process.

4. When peroxide of manganese and muriatic acid are heated together, a mutual decomposition is effected; the hydrogen, by reason of its superior affinity, unites with a portion of oxygen from the peroxide of manganese to form water, and the chlorine escapes in a gaseous form; the protoxide of manganese then combines with an excess of muriatic acid to form proto-muriate of manganese.

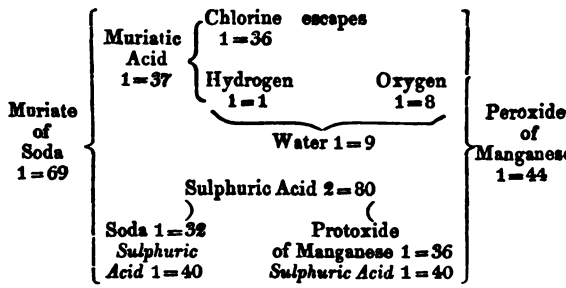


CHLORINE.

Second Process.

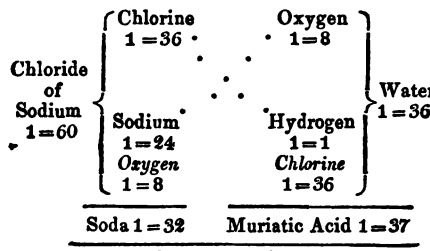
5. When muriate of soda, dilute sulphuric acid, and

peroxide of manganese, are heated together, a part of the sulphuric acid combines with the soda to form sulphate of soda, the muriatic acid which is liberated then suffers decomposition, at the same time the peroxide of manganese gives up an atom of oxygen, which combines with an atom of hydrogen from the muriatic acid to form water, the chlorine is liberated, and the protoxide of manganese then combines with another portion of sulphuric acid to form proto-sulphate of manganese. The products are therefore chlorine, water, sulphate of soda, and proto-sulphate of manganese.



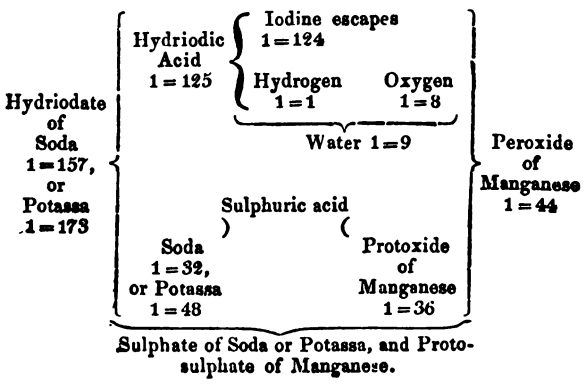
THE DECOMPOSITION WHICH TAKES PLACE WHEN A CHLORIDE IS DISSOLVED IN WATER.

6. If chloride of sodium be dissolved in water, the chlorine takes a portion of hydrogen from the water to form muriatic acid; while the oxygen combines with the sodium to form soda, the product is therefore a solution of muriate of soda; whenever any soluble chloride is thrown into water, the same decomposition always occurs.



IODINE, ATOMIC WEIGHT 124.

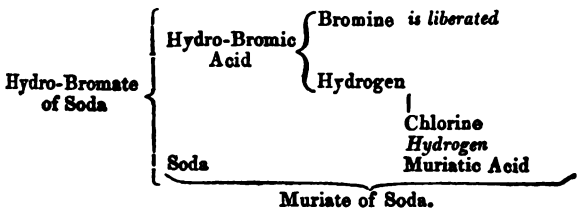
7. Iodine exists in the mother liquor after lixiviating kelp, combined with hydrogen and soda or potassa forming hydriodate of soda or potassa, for the decomposition of this salt sulphuric acid and peroxide of manganese are required; the sulphuric acid combines with the soda or potassa and sets the hydriodic acid at liberty, a portion of oxygen from the peroxide of manganese immediately combines with the hydrogen to form water and sets the iodine at liberty which sublimes as a violet-coloured vapour: the products are, free Iodine, water, sulphate of soda, and proto-sulphate of manganese.



8. The same decomposition occurs when an iodide is dissolved in water as attends the solution of a chloride, except that in one case a muriate, in the other a hydriodate is formed.

BROMINE, ATOMIC WEIGHT 78?

9. Bromine is only found in minute quantities in sea-water, in the same state of combination as iodine; when a current of chlorine is driven through such a fluid, it seizes on the hydrogen and with it forms muriatic acid, while the bromine is set at liberty, the muriatic acid then unites with the soda to form muriate of soda: the products are bromine and muriate of soda.



BROMIDES have similar properties with regard to water to the two preceding.

FLUORINE, ATOMIC WEIGHT 18?

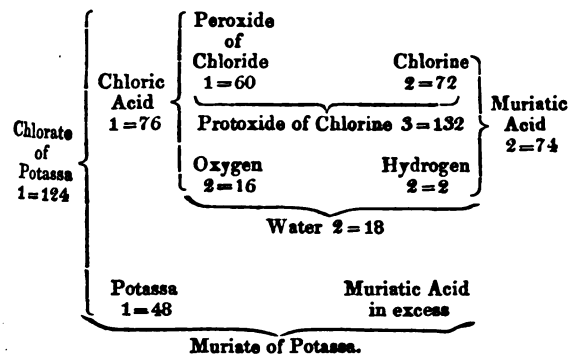
10. The decompositions relating to fluorine will be explained in another part.—(*Vide* 25.)

PART II.

Decompositions which occur during the combination of the five preceding bodies to form new compounds.

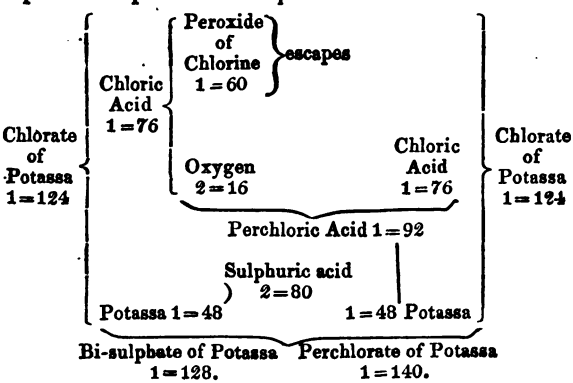
PROTOXIDE OF CHLORINE, ATOMIC WEIGHT 44.

11. The following decomposition takes place when muriatic acid and chlorate of potassa are heated together: 2 atoms of muriatic acid are required for the complete decomposition of 1 atom of the salt; 1 atom of chloric acid is compounded of 5 atoms of oxygen = 40, and 1 atom of chlorine = 36, 2 atoms of muriatic acid are compounded of 2 chlorine = 74, and 2 hydrogen = 2; 2 atoms of hydrogen from the muriatic acid unite with 2 of oxygen from the chloric acid to form water, leaving 1 atom of peroxide of chlorine; the 2 atoms of chlorine resulting from the decomposition of the muriatic acid immediately combine with the atom of peroxide and converts it into 3 atoms of protoxide of chlorine; the potassa then combines with an excess of muriatic acid to form a muriate of potassa; the products are, water, protoxide of chlorine, and muriate of potassa.



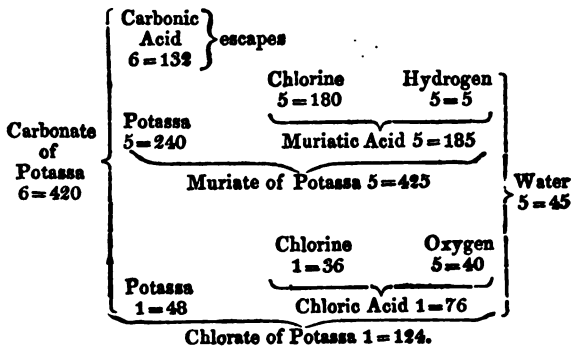
PEROXIDE OF CHLORINE, ATOMIC WEIGHT 60.

12. The materials used in making peroxide of chlorine are, chlorate of potassa and sulphuric acid; the sulphuric acid combines with the potassa and sets the chloric acid at liberty, which is immediately decomposed into peroxide of chlorine and oxygen; the oxygen combines with another portion of chloric acid to form perchloric acid, while the peroxide of chlorine escapes in a gaseous form; the products are, peroxide of chlorine, sulphate and perchlorate of potassa.



CHLORATE OF POTASSA, ATOMIC WEIGHT 124.

13. Gaseous chlorine and a strong solution of carbonate of potassa are used in the manufacture of this salt; the water here suffers decomposition, 1 atom of chlorine requires 5 of oxygen to be converted into chloric acid; therefore 5 of water suffers decomposition, and 5 atoms of hydrogen which are liberated at the same time combine with 5 of chlorine to form 5 of muriatic acid, so that for every atom of chloric acid there are 5 atoms of muriatic acid formed at the same time; the products are, chlorate and muriate of potassa.



PERCHLORATE OF POTASSA, ATOMIC WEIGHT 140.

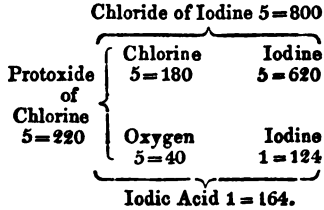
14. The decomposition which occurs here is already described under the head PEROXIDE OF CHLORINE.

Note.—The proportions in which oxygen and chlorine combine are not yet finally agreed on, especially that of peroxide of chlorine: Sir H. Davy states its composition to be 1 chlorine +4 oxygen; Count Stadion states its composition to be 1 chlorine +3 oxygen. I have employed the latter, because it is supported

by some facts lately elicited by Leibig, and because it allows a more simple explanation of the changes which occur during the production of it.

IODIC ACID, ATOMIC WEIGHT 164.

15. In making this acid, protoxide of chlorine is passed over powdered iodine; 5 atoms of iodine combine with 5 of chlorine to form 5 of chloride of iodine, while another atom of iodine combines with 5 of oxygen to form 1 of Iodic acid; therefore for every atom of iodic acid 5 atoms of chloride of iodine are also produced.



The decomposition which takes place in making iodate of potass will be described in sections 22 and 23.

BROMATE OF POTASSA.

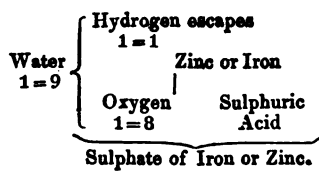
Vide Hydriodate of Potassa, section 22.

PART III.

Decompositions which occur during the formation of the simple non-metallic combustibles, and also their compounds with the supporters of combustion.

HYDROGEN, ATOMIC WEIGHT 1.

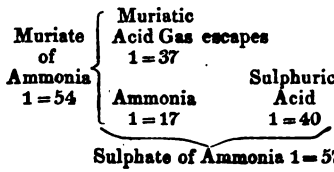
16. Iron or zinc, and diluted sulphuric, are employed for the production of hydrogen; by their mutual action the water is decomposed, the oxygen combines with the metal to form protoxide of iron, which with the acid forms proto-sulphate of iron, while the hydrogen escapes in a gaseous form.



HYDROGEN AND CHLORINE, OR MURIATIC ACID IN A STATE OF GAS, ATOMIC WEIGHT 37.

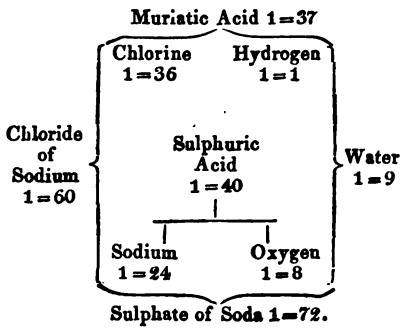
17. Muriate of ammonia and sulphuric acid are here employed; the sulphuric acid combines with the ammonia

to form sulphate of ammonia, and muriatic acid escapes in a gaseous form.



LIQUID MURIATIC ACID.

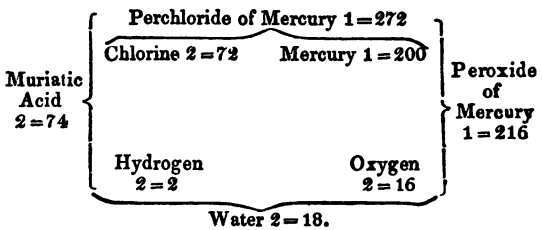
18. Chloride of sodium and dilute sulphuric acid are employed; the water here suffers decomposition, 1 atom of oxygen combines with an atom of sodium to form soda, which with the sulphuric acid forms sulphate of soda, while the hydrogen combines with the chlorine to form muriatic acid, which distils over in combination with water.



The old manner of accounting for this decomposition is explained in the former diagram.

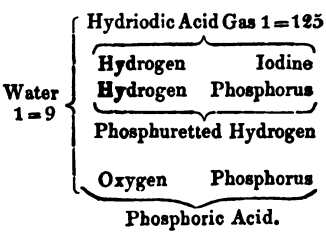
19. Whenever muriatic acid gas is subjected to the action of peroxide of mercury, both substances are com-

pletely decomposed; muriatic acid is composed of 1 atom of chlorine and 1 atom of hydrogen, peroxide of mercury is composed of 2 of oxygen and 1 of mercury; 2 of oxygen require 2 of hydrogen for its conversion into water, therefore 1 atom of peroxide is required for the decomposition of 2 of muriatic acid, 2 atoms of chlorine which result then combine with 1 of mercury to form perchloride of mercury; so that by the decomposition of 1 atom of peroxide, 2 atoms of water and 1 of perchloride of mercury result.



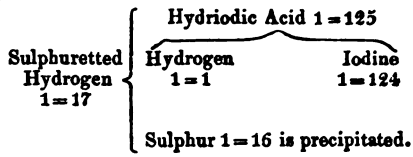
HYDRIODIC ACID GAS, ATOMIC WEIGHT 125.

20. When moist iodine and phosphorus come in contact, the water suffers decomposition, its oxygen unites with the phosphorus to form phosphoric acid; and the hydrogen combines with the iodine and occasionally a small portion of phosphorus to form hydriodic acid gas and phosphuretted hydrogen.



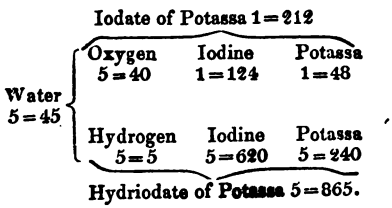
HYDRIODIC ACID.

21. When sulphuretted hydrogen gas is driven through water in which finely-powdered iodine is suspended, 1 atom of hydrogen combines with an atom of iodine to form one atom of hydriodic acid, and an atom of sulphur is precipitated.



HYDRIODATE OF POTASSA, ATOMIC WEIGHT 173.

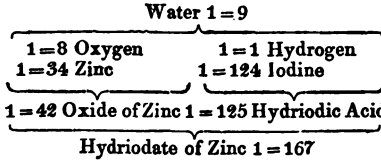
22. I. Iodine and caustic potassa are here employed; 5 atoms of water are decomposed 5 of oxygen resulting, unite with one of iodine to form 1 of iodic acid, which with an atom of potassa forms 1 of iodate of potassa, while the 5 atoms of hydrogen with 5 of iodine form 5 of hydriodic acid, this with 5 of potassa form 5 atoms of hydriodate of potassa: the products are, 1 atom of iodate of potassa which is precipitated, and 5 of hydriodate of potassa which remains in solution.



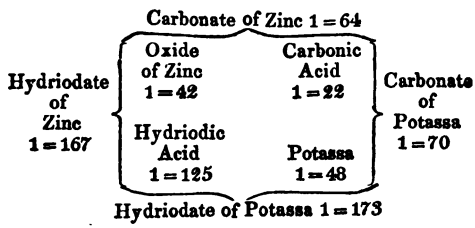
HYDRIODATE OF POTASSA.

23. II. A. This process is divided into two parts:— 1st. Zinc, iodine, and water, are suffered to remain together

for several weeks; the water suffers decomposition, the oxygen unites with the zinc to form oxide of zinc, and the hydrogen with the iodine forms hydriodic acid; these two unite together to form hydriodate of zinc, which remains in solution.



24. II. B. When carbonate of potassa is added to the hydriodate of zinc, a transposition of the acids is effected, carbonate of zinc and hydriodate of potassa being now formed.

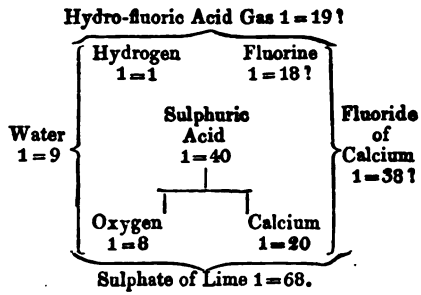

Carbonate of Zinc 1 = 64
Hydriodate of Zinc 1 = 167
Oxide of Zinc 1 = 42
Carbonic Acid 1 = 22
Hydriodic Acid 1 = 125
Potassa 1 = 48
Carbonate of Potassa 1 = 70
Hydriodate of Potassa 1 = 173

Similar decompositions occur in the formation of hydro-bromic acid and hydro-bromate of potassa.

HYDRO-FLUORIC ACID, ATOMIC WEIGHT 19?

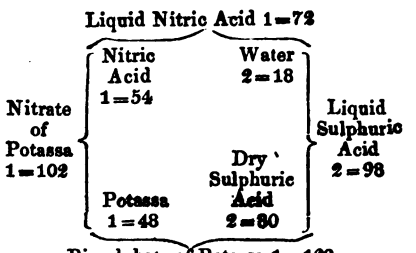
25. When sulphuric acid and fluoride of calcium are heated together, the water existing in the sulphuric acid suffers decomposition, an atom of oxygen with the calcium forms lime, this with the sulphuric acid forms

sulphate of lime, while the hydrogen combines with the fluorine to form hydro-fluoric acid which escapes.



THE COMPOUNDS OF NITROGEN AND OXYGEN, NITRIC ACID, ATOMIC WEIGHT 54.

26. When nitrate of potassa and sulphuric acid are heated together, the nitrate of potassa suffers decomposition, 1 atom of nitric acid requires 2 of water from the sulphuric acid to convert it into liquid nitric acid which distils over, while 2 atoms of dry sulphuric acid combine with 1 of potassa to form 1 of bisulphate of potassa which remains.

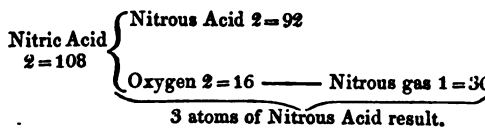


Note.—One atom of sulphuric acid is sufficient for the decomposition of one atom of nitrate of potassa; but one atom of nitric

acid requires two atoms of waters; consequently, since an atom of liquid sulphuric acid only contains one atom of water, two atoms of sulphuric acid are employed to give the required quantity of water. There is also another advantage in using a double quantity of sulphuric, viz. that bisulphate of potassa is formed, which is far more soluble, and consequently got out of a retort with greater ease, than the sulphate of potassa. But in manufacturing large quantities of this acid, where this objection does not apply, they save half the sulphuric acid by adding the required quantity of water.

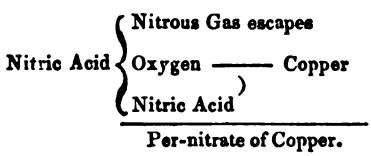
LIQUID NITROUS ACID, ATOMIC WEIGHT 46.

27. When a current of nitrous gas is driven through nitric acid, 2 atoms of nitric acid are by the abstraction of 2 of oxygen converted into 2 atoms of nitrous acid, while the 2 of oxygen with one of nitrous gas form 1 of nitrous acid: three atoms of nitrous acid therefore result, which remain in solution together with an excess of nitric acid.



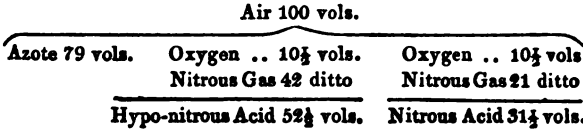
NITROUS GAS, ATOMIC WEIGHT 30.

28. When nitric acid is poured on copper filings, part of the nitric acid suffers decomposition; nitrous gas escapes, while the excess of oxygen combines with the copper to form peroxide of copper, which with another portion of nitric acid forms nitrate of copper; the same decomposition attends the solution of several other metals in this acid.



ANALYSIS OF AIR BY NITROUS GAS.

29. When 100 vols. of nitrous gas are mixed with 100 of air, an absorption occurs generally amounting to 84 vols. The following diagram will explain the reason why this should be divided by 4.

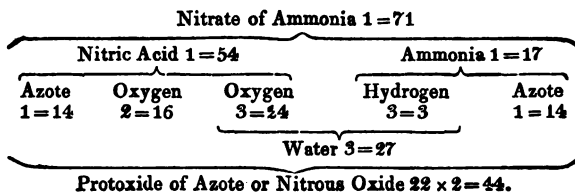


The sum of these two will be 84; which, divided by 4, will give 21 of oxygen in 100 of air.

NITROUS OXIDE, ATOMIC WEIGHT 22.

30. Nitrate of ammonia, the salt here employed is compounded of nitric acid and ammonia, and is destitute of water; nitric acid is compounded of 5 of oxygen and 1 of azote, ammonia is compounded of 3 hydrogen and 1 azote; both the nitric acid and the ammonia suffer complete decomposition, 3 atoms of hydrogen combine with 3 of oxygen to form 3 of water, the remaining 2 of oxygen then combine with 2 of azote resulting from the decomposition of both acid and base to form nitrous oxide which may be collected in its gaseous state; water and

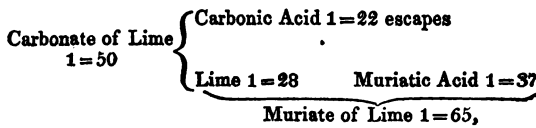
nitrous oxide gas are therefore the sole products of the decomposition of this salt.



An explanation of the decompositions which occur during the formation of charcoal by the destructive distillation of animal and vegetable matter, will be found under the head of Animal and Vegetable Chemistry.

CARBONIC ACID GAS, ATOMIC WEIGHT 22.

31. Carbonate of lime and muriatic acid are here employed; the muriatic acid combines with the lime to form muriate of lime, while the carbonic acid escapes in a gaseous form.

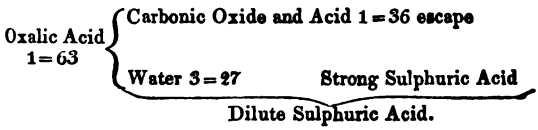


CARBONIC OXIDE, ATOMIC WEIGHT 14.

First Process.

32. Oxalic acid by the action of concentrated sulphuric acid is entirely resolved into water which is retained by

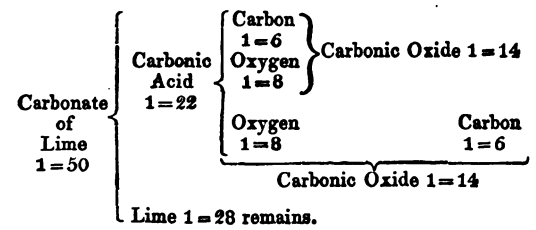
the sulphuric acid, and carbonic oxide and acid which are liberated in a gaseous form.



CARBONIC OXIDE.

Second Process.

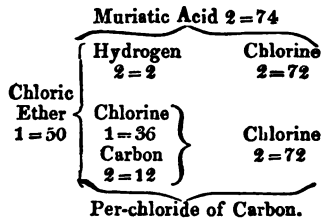
33. When any carbonate is exposed to the combined action of a red heat and charcoal, the carbonic acid takes an additional quantity of carbon into solution and is converted into carbonic oxide, which may be collected in the usual manner, leaving the base in a caustic state. Ex. carbonate of lime.



PERCHLORIDE OF CARBON, ATOMIC WEIGHT 120.

34. When oleliant gas and chlorine are mixed together, the two combine to form chloric ether; if this chloric ether be exposed to the combined action of solar light and an excess of chlorine, the hydrogen which is contained in the chloric ether then unites with a portion of chlorine to form muriatic acid which escapes, and the

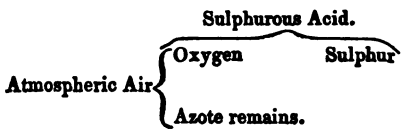
carbon combines with another portion of chlorine to form perchloride of carbon.



SULPHUROUS ACID, ATOMIC WEIGHT 32.

First Process.

35. When sulphur is burnt in atmospheric air, sulphurous acid is formed by the union of the sulphur and oxygen, and the azote remains unacted on.

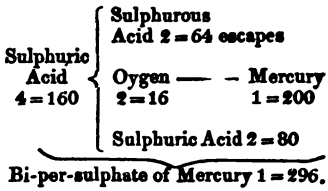


SULPHUROUS ACID.

Second Process.

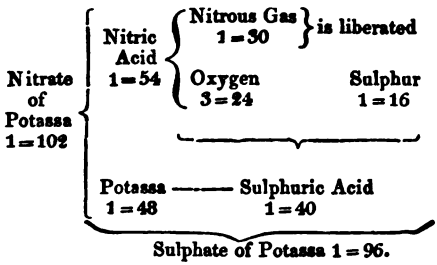
36. By the action of mercury at a boiling temperature on sulphuric acid, peroxide of mercury and sulphurous acid are formed; every atom of mercury requires 2 atoms of oxygen for its conversion into peroxide, consequently 2 atoms of sulphuric acid form 1 atom of peroxide of mercury and 2 of sulphurous acid; the atom of peroxide of mercury then combines with 2 of undecomposed acid

to form one of bi-per-sulphate of mercury, and the sulphurous acid escapes in a gaseous form.

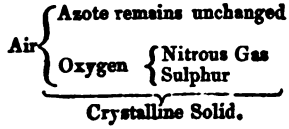

Sulphurous Acid 2 = 64 escapes
Sulphuric Acid 4 = 160
Oygen 2 = 16
Mercury 1 = 200
Sulphuric Acid 2 = 80
Bi-per-sulphate of Mercury 1 = 296.

SULPHURIC ACID, ATOMIC WEIGHT 40.

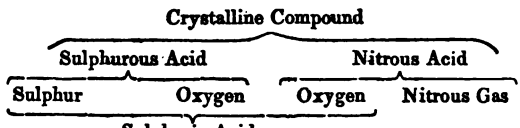
37. A. When sulphur and nitre are ignited in contact with the air, 1 atom of nitrate of potassa suffers complete decomposition, 1 atom of sulphur = 16 takes 3 of oxygen from the nitric acid to form 1 atom of dry sulphuric acid which remains combined with the potassa, thus:


Nitrate of Potassa 1 = 102
Nitric Acid 1 = 54
Nitrous Gas 1 = 30
is liberated
Oxygen 3 = 24
Sulphur 1 = 16
Potassa 1 = 48
Sulphuric Acid 1 = 40
Sulphate of Potassa 1 = 96.

37. B. Another portion of sulphur by combustion is converted into sulphurous acid, at the same time the nitrous gas absorbs oxygen from the air, and is converted into nitrous acid; the two gases then condense into a white crystalline compound in the following manner:



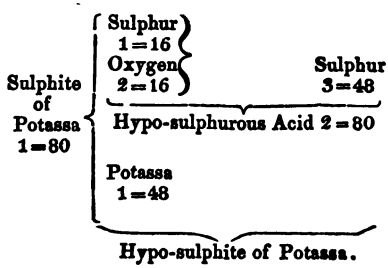
37. C. As soon as this crystalline solid falls into the water placed for its reception, the sulphurous acid takes a portion of oxygen from the nitrous acid and is converted into sulphuric acid, and the nitrous gas is liberated to perform the same office as often as may be necessary.



HYPO-SULPHUROUS ACID, ATOMIC WEIGHT 40.

First Process.

38. When a solution of sulphurous acid or any sulphite is digested with sulphur, 1 atom of sulphurous acid is converted into 2 atoms of hypo-sulphurous acid.

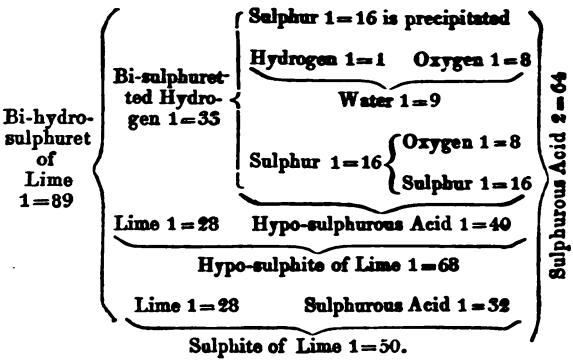


HYPO-SULPHITE OF LIME.

Second Process.

39. When sulphurous acid gas is driven through bi-hydro-sulphuret of lime, the excess of sulphur is deposited, at the same time half the oxygen from the sulphurous acid combines with the hydrogen from the hydro-

sulphuret to form water, while the sulphur and oxygen which remain take an additional dose of sulphur into solution to form hypo-sulphurous acid which remains in combination with 1 of lime, the remaining atom of lime combines with one of sulphurous acid to form sulphite of lime.

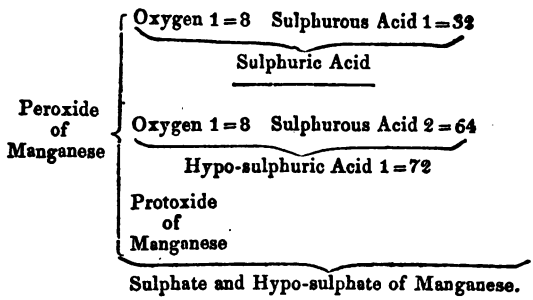


Note.—The atomic weight of hypo-sulphurous acid is still a subject of dispute among chemists. Until lately its composition was stated to be 1 of sulphur + 1 of oxygen, making its atomic weight 24: but, according to some recent experiments, made by Dr. Thompson, it appears to be compounded of 2 of sulphur and 1 of oxygen, which would make the atomic weight 40. Which of these two be correct I cannot say; but I prefer the latter in the present instance, because it most easily explains the changes which here occur.

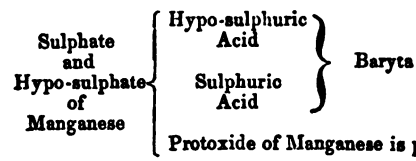
HYPO-SULPHURIC ACID, ATOMIC WEIGHT 72.

40. A. By passing a current of sulphurous acid gas through peroxide of manganese, suspended in water, the manganese is partially de-oxidized, the oxygen combines with two separate portions of sulphurous acid to form

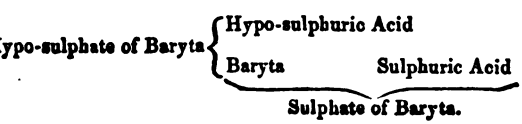
sulphuric and hypo-sulphuric acids, both combine with separate portions of protoxide of manganese to form soluble salts; viz. sulphate and hypo-sulphate of manganese.


Oxygen 1 = 8 Sulphurous Acid 1 = 32
Sulphuric Acid
Peroxide of Manganese
Oxygen 1 = 8 Sulphurous Acid 2 = 64
Hypo-sulphuric Acid 1 = 72
Protoxide of Manganese
Sulphate and Hypo-sulphate of Manganese.

40. B. When a solution of caustic baryta is added to the sulphate and hypo-sulphate of manganese which is formed, hypo-sulphate and sulphate of baryta and protoxide of manganese are formed, the first remains in solution and the two latter are precipitated.

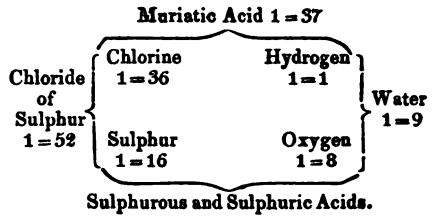


40. C. When sulphuric acid is added to hypo-sulphate of baryta, insoluble sulphate of baryta is precipitated and pure hypo-sulphuric acid remains in solution.



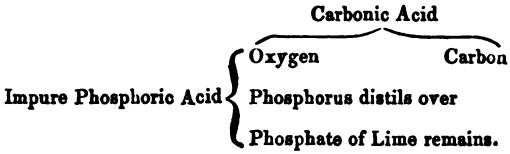
ACTION OF CHLORIDE OF SULPHUR ON WATER.

41. The water suffers decomposition, its hydrogen combines with the chlorine to form muriatic acid, and the sulphur will combine with the oxygen to form sulphurous and sulphuric acids.


Muriatic Acid 1 = 37
Chlorine 1 = 36
Hydrogen 1 = 1
Chloride of Sulphur 1 = 52
Water 1 = 9
Sulphur 1 = 16
Oxygen 1 = 8
Sulphurous and Sulphuric Acids.

PHOSPHORUS, ATOMIC WEIGHT 12.

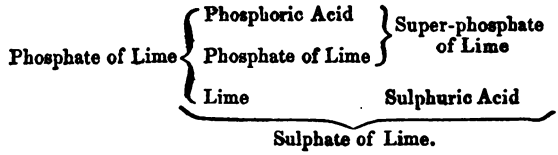
42. By the action of carbon at a red heat on impure phosphoric acid the phosphorus loses its oxygen and distils over; while the carbon and oxygen unite to form carbonic acid and there remains a portion of phosphate of lime with which the phosphoric acid was contaminated.



IMPURE PHOSPHORIC ACID.

43. When sulphuric acid is added to bone earth, it combines with a part of the lime and the phosphoric and carbonic acids are liberated; the first dissolves another portion of phosphate and forms super-phosphate of lime

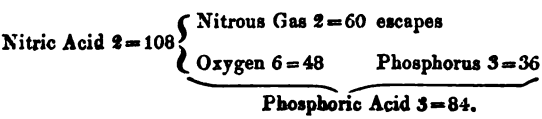
which remains in solution, while carbonic acid escapes in a gaseous state.



PURE PHOSPHORIC ACID, ATOMIC WEIGHT 28.

First Process.

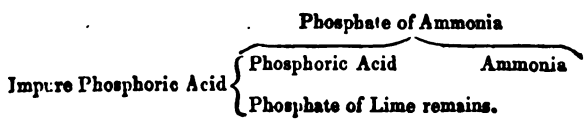
44. The nitric acid suffers decomposition, the phosphorus takes the oxygen and forms phosphoric acid, and nitrous gas escapes.



PHOSPHORIC ACID.

Second Process.

45. A. On the addition of ammonia to a solution of impure phosphoric acid, phosphate of ammonia is formed, and phosphate of lime which was held in solution by the phosphoric acid is precipitated.



45. B. When phosphate of ammonia is heated, ammonia is given off, and pure phosphoric acid remains.

Phosphate of Ammonia 1 = 45 { Ammonia 1 = 17 Heat
Pure Phosphoric Acid 1 = 28 remains.

Note.—This is the easiest, cheapest, and perhaps the best mode of obtaining pure phosphoric acid.

PROTO-CHLORIDE OF PHOSPHORUS, ATOMIC WEIGHT 48.

46. Phosphorus by the aid of heat deprives the per-chloride of mercury of an atom of chlorine, and forms proto-chloride of phosphorus which is volatile, and proto-chloride of mercury which remains.

Proto-chloride of Phosphorus 1 = 48

Per-chloride of Mercury 1 = 272 { Chlorine 1 = 36 Phosphorus 1 = 12
Proto-chloride of Mercury 1 = 236 } remains

PHOSPHOROUS ACID, ATOMIC WEIGHT 20.

47. When proto-chloride of phosphorus is dissolved in water, the water suffers decomposition, an atom of oxygen combines with an atom of phosphorus, and one atom of hydrogen combines with an atom of chlorine; the products are phosphorous and muriatic acids, both of which remain in solution.

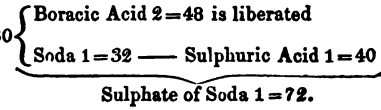
Phosphorous Acid 1 = 20

Proto-chloride of Phosphorus 1 = 48 { Phosphorus 1 = 12, Oxygen 1 = 8
Chlorine 1 = 36 Hydrogen 1 = 1 } Water 1 = 9

Muriatic Acid 1 = 37.

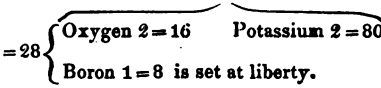
BORACIC ACID, ATOMIC WEIGHT 24?

48. When sulphuric acid is added to a strong solution of borate of soda, the salt suffers decomposition; sulphate of soda and free boracic acid result.



BORON, ATOMIC WEIGHT 8?

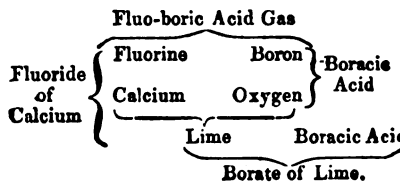
49. Potassium by the aid of heat seizes the oxygen and sets the boron at liberty; potassa and boron result.



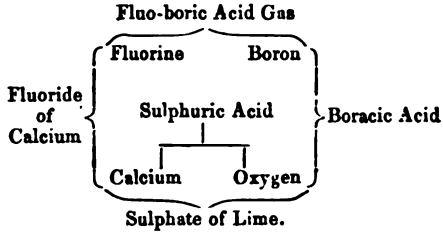
Note.—The atomic weight of boron and its oxide is by no means satisfactorily decided; till then the above numbers must remain.

FLUO-BORIC ACID GAS.

50. Fluoride of calcium and boracic acid are here employed, the fluorine combines with the boron, and the oxygen with the calcium; fluo-boric acid gas and lime result, the lime combines with a portion of boracic acid and forms borate of lime which remains.



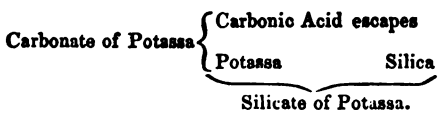
51. When fluoride of calcium, boracic and sulphuric acids, are heated together, fluo-boric acid gas and sulphate of lime are formed, thus:



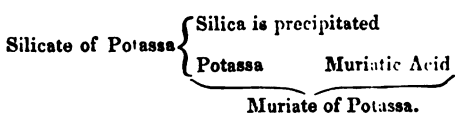
Note.—The data given by those chemists who have experimented on the subject for ascertaining its atomic constitution are so conflicting and unsatisfactory, that I have thought it best not to perpetuate error by assigning it any atomic equivalent, until we have more certain data to work on.

PURE SILICA, ATOMIC WEIGHT 16.

52. A. When powdered flints or sand are strongly heated with carbonate of potassa, silicate of potassa is formed and carbonic acid escapes.

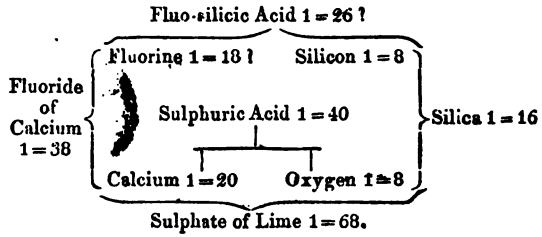


52. B. When muriatic acid is added to a solution of silicate of potassa, muriate of potassa is formed and silica is precipitated.



FLUO-SILICIC ACID GAS, ATOMIC WEIGHT 26?

53. When fluoride of calcium, silica, and sulphuric acid, are heated together, the silica gives up its oxygen to the calcium to form lime, which remains in combination with the sulphuric acid, at the same time the fluorine and silicium combine together to form fluo-silicic acid gas.


Fluo-silicic Acid 1 = 26 ?
Fluorine 1 = 18 ?
Silicon 1 = 8
Fluoride of Calcium 1 = 38
Sulphuric Acid 1 = 40
Silica 1 = 16
Calcium 1 = 20
Oxygen 1 = 8
Sulphate of Lime 1 = 68.

PART IV.

Compounds between the simple non-metallic Combustibles.

NITROGEN AND HYDROGEN FORMING AMMONIA, ATOMIC WEIGHT 17.

MURIATE OF AMMONIA, ATOMIC WEIGHT 54.

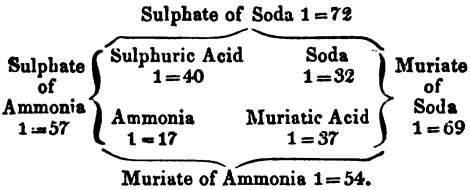
54. A. The liquor which is formed during the destructive distillation of coal contains a large quantity of ammonia, combined with carbonic and hydrocyanic acids and sulphuretted hydrogen; when sulphuric acid is added, sulphate of ammonia is formed, while the sulphuretted hydrogen, carbonic and hydrocyanic acids, are set at liberty.

Gas Liquor { Hydrocyanic Acid, Sulphuretted Hydrogen, Carbonic Acid } escape

Gas Liquor { Ammonia 1 = 17 Sulphuric Acid 1 = 40 } Sulphate of Ammonia 1 = 57.

54. B. Sulphate of ammonia and muriate of soda are here employed, the sulphuric acid combines with the soda and

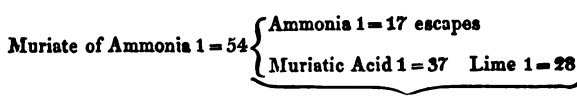
the muriatic with the ammonia to form sulphate of soda and muriate of ammonia.



Note.—The following process, to which the two preceding diagrams refer, is the one commonly employed for obtaining large quantities of muriate of ammonia. The liquor which condenses during the formation of coal gas, and which is commonly known under the name of *gas liquor*, is first neutralized by sulphuric acid, and then evaporated down to dryness. The sulphate of ammonia which results is then dissolved in water, and mixed with a solution of common salt, at a boiling temperature; mutual decomposition is effected, sulphate of soda and muriate of ammonia are formed, the two salts are then separated by crystallization; and, lastly, the muriate of ammonia is sublimed.

AMMONIACAL GAS, OR SOLUTION.

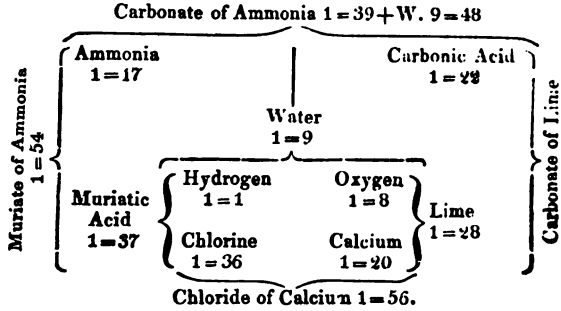
55. Muriate of ammonia and caustic lime are employed, the muriatic acid combines with the lime to form muriate of lime, and the ammonia escapes.



CARBONATE OF AMMONIA, ATOMIC WEIGHT 118.

56. When carbonate of lime and muriate of ammonia are heated together, the carbonic acid combines with the

ammonia, the chlorine with the calcium, and the oxygen with the hydrogen; the products are hydrated sesqui-carbonate of ammonia, and chloride of calcium.

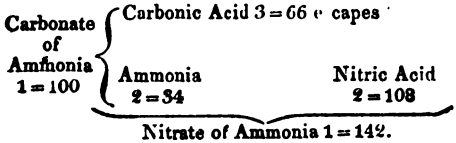


Note.—The proportions of the ingredients which are recommended would, provided there were no loss, yield a salt having the atomic constitution represented in the diagram; but, during the process of sublimation, 3 atoms of the salt lose 1 of ammonia, and by that means is converted into a true sesqui-carbonate of ammonia, compounded of 1 of ammonia =17, +1½ of carbonic acid =33, and 1 of water =9, making its atomic weight 59; or, to avoid the anomaly of a half-atom, it may be represented thus:

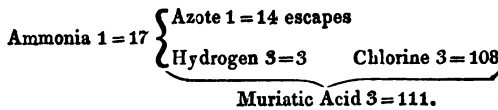
2 atoms of ammonia	=34
3 ditto of carbonic acid	=66
2 ditto of water	=18
1 atom of sesqui-carbonate of ammonia	=118

NITRATE OF AMMONIA.

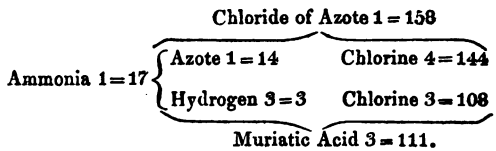
56. The nitric acid seizes the ammonia to form nitrate of ammonia, while the carbonic acid escapes. This example will suffice for all the other salts of ammonia.



58. When a current of chlorine gas is driven through liquid ammonia, the hydrogen unites with the chlorine to form muriatic acid, and the azote is liberated in its gaseous form; thus,



But if a bottle full of chlorine gas be inverted in a solution of muriate of ammonia, muriatic acid and free azote will be formed as before; the azote however, as soon as it is liberated, coming in contact with an atmosphere of chlorine, combines with it to form chloride of azote.

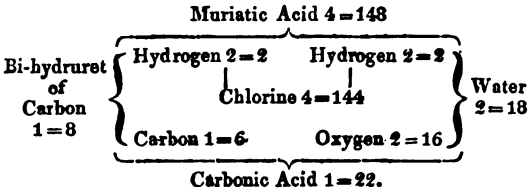


Note.—Of all the compounds with which the chemist has to deal, not excepting fulminating silver and gold, chloride of azote is by far the most dangerous, even a small particle of dust being often sufficient to cause its explosion. I merely mention this as a caution to those who might feel inclined to experimentise on this substance.

CARBON AND HYDROGEN.—ACTION OF CHLORINE ON BI-HYDRURET OF CARBON.

59. Bi-hydruret of carbon by the action of moist chlorine is completely decomposed; 2 atoms of chlorine combine with 2 of hydrogen from the bi-hydruret, 2 atoms of water also suffer decomposition, 2 atoms of hydrogen

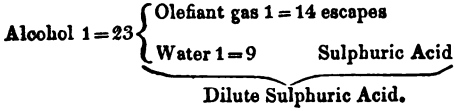
combine with 2 of chlorine, and 2 of oxygen combine with 1 of carbon; the products are, 4 atoms of muriatic acid, and 1 atom of carbonic acid.



Note.—The above change occurs, when 4 volumes or atoms of chlorine are employed for the decomposition of 1 of bi-hydruret of carbon.

PRODUCTION OF OLEFIANT GAS, ATOMIC WEIGHT 14.

60. Alcohol and sulphuric acid are here employed; alcohol is compounded of 3 of hydrogen, 2 of carbon, and 1 of oxygen, or 1 of olefiant gas and 1 of water; the sulphuric acid at a boiling temperature combines with the water and liberates olefiant gas.

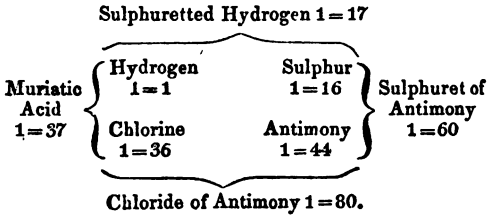


HYDROGEN AND SULPHUR, SULPHURETTED HYDROGEN, ATOMIC WEIGHT 17.

First Process.

61. Both the sulphuret of antimony and muriatic acid are decomposed, the hydrogen unites with the sulphur to form sulphuretted hydrogen, the chlorine with the antimony to form chloride of antimony, which imme-

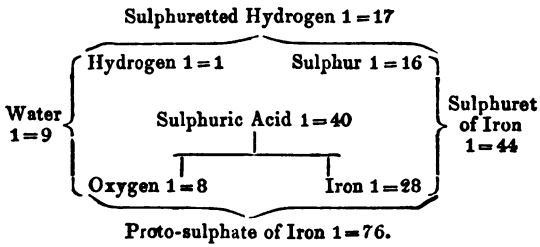
diately decomposes the water and forms proto-muriate of antimony.



SULPHURETTED HYDROGEN.

Second Process.

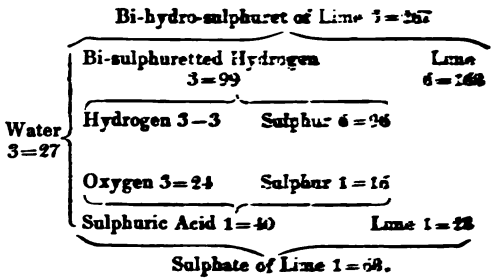
62. The sulphur combines with the hydrogen, and the oxygen with the metallic iron; the products are sulphuretted hydrogen and protoxide of iron, which combine with the sulphuric acid to form proto-sulphate of iron.



BI-HYDRO-SULPHURET OF LIME, ATOMIC WEIGHT 89.

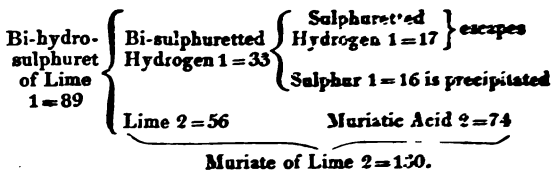
63. When sulphur, lime, and water, are boiled together, the water suffers decomposition, 3 atoms of oxygen combine with one of sulphur, to form sulphuric acid, which forms, with 1 of lime, sulphate of lime; 3 atoms of hydrogen then combine with 6 of sulphur to form 3 of

bi-sulphuretted hydrogen, which with 6 of lime forms 3 atoms of bi-hydro-sulphuret of lime.



SULPHUR PRECIPITATUM.

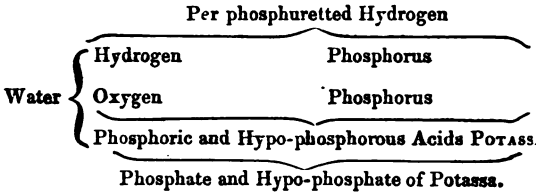
64. The muriatic acid combines with the lime, sulphuretted hydrogen escapes, and sulphur is precipitated.



PER-PHOSPHURETTED HYDROGEN, ATOMIC WEIGHT NOT YET DECIDED.

65. The water suffers decomposition, its hydrogen unites with a portion of phosphorus to form per-phosphuretted hydrogen, which escapes, and the oxygen combines with another portion of phosphorus to form phosphoric and

hypo-phosphorous acids, which remain in combination with the potassa.

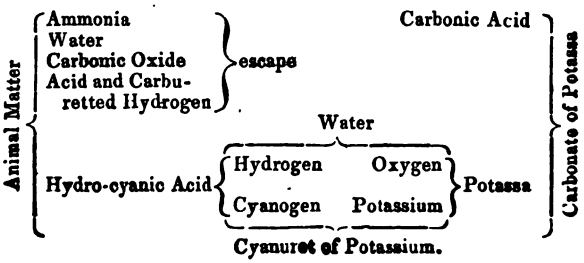


Selenuretted hydrogen is procured in the same way as sulphuretted hydrogen.

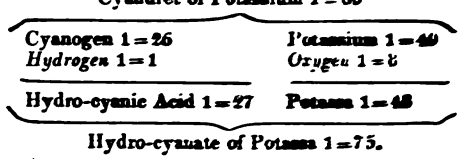
PRUSSIAN BLUE OF COMMERCE.

COMPOSITION VARIABLE.

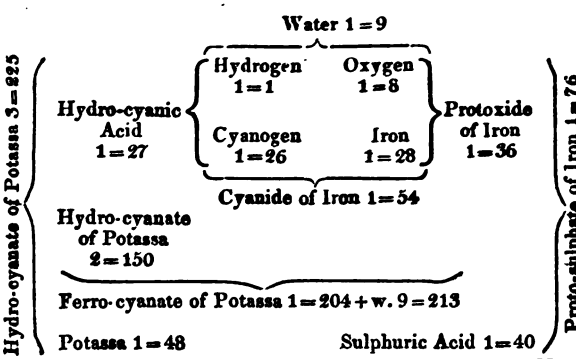
66. A. When animal matter and carbonate of potassa are heated together, the animal matter suffers complete decomposition, ammonia, water, carbonic oxide and acid, and carburetted hydrogen, all escape, at the same time hydrocyanic acid is formed, by combination between portions of carbon, azote, and hydrogen, which combines with a portion of potassa to form hydro-cyanate of potassa, this is immediately resolved into water, which escapes, and cyanuret of potassium, which remains diffused through carbonate of potassa.



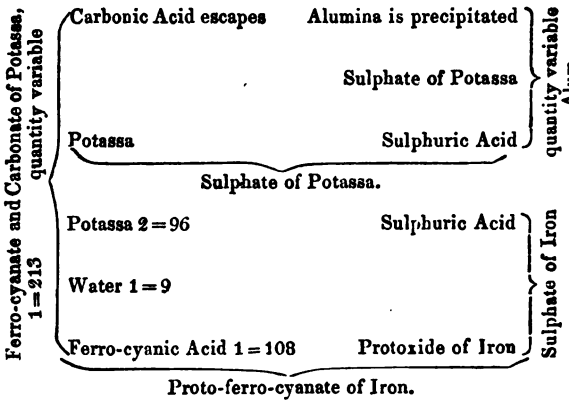
66. B. When the cyanuret of potassium is dissolved in *water,* hydro-cyanate of potassa is formed thus:


Cyanuret of Potassium 1 = 66
Cyanogen 1 = 26
Hydrogen 1 = 1
Potassium 1 = 39
Oxygen 1 = 8
Hydro-cyanic Acid 1 = 27
Potassa 1 = 48
Hydro-cyanate of Potassa 1 = 75.

66. C. When the mixture thus obtained, consisting of hydro-cyanate and carbonate of potassa, is added to a mixture of two parts of alum and one of sulphate of iron, (the alum and carbonate of potassa are not essential to the formation of pure Prussian blue,) 1 atom of sulphate of iron decomposes 1 of hydro-cyanate of potassa. 1 atom of hydro-cyanic acid decomposes an atom of protoxide of iron, water and cyanide of iron are thus formed, the cyanide of iron then combines with 2 atoms of hydro-cyanate of potassa to form 1 of ferro-cyanate of potassa.


Water 1 = 9
Hydrogen 1 = 1
Oxygen 1 = 8
Hydro-cyanic Acid 1 = 27
Cyanogen 1 = 26
Iron 1 = 28
Protoxide of Iron 1 = 36
Cyanide of Iron 1 = 54
Hydro-cyanate of Potassa 2 = 150
Hydro-cyanate of Potassa 3 = 225
Ferro-cyanate of Potassa 1 = 204 + w. 9 = 213
Proto-sulphate of Iron 1 = 76
Potassa 1 = 48
Sulphuric Acid 1 = 40
Sulphate of Potassa 1 = 88.

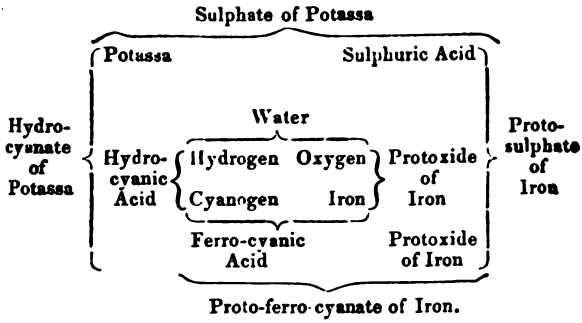
66. D. The ferro-cyanate of potassa so formed then decomposes a fresh quantity of sulphate of iron to form 1 atom of ferro-cyanate of the protoxide of iron, which by exposure to the air is converted into per-ferro-cyanate of iron and sulphate of potassa; at the same time the alum and carbonate of potassa are both decomposed, sulphate of potassa is formed, alumina is precipitated, and carbonic acid gas escapes.



Explanation of the changes which occur during the formation of Prussian Blue, on the supposition that ferro-cyanic acid contains no hydrogen.

67. When a solution of hydro-cyanate of potassa is added to a proto-salt of iron, both the hydro-cyanic acid and protoxide of iron suffer decomposition, a portion of oxygen combines with the hydrogen to form water, the metallic iron then combines with the cyanogen to form ferro-cyanic acid, which combines with another portion of protoxide of iron to form proto-ferro-cyanate of iron, this,

by exposure to the air, absorbs oxygen, and is converted into per-ferro-cyanate of iron; the sulphuric acid and potassa then combine to form sulphate of potassa.

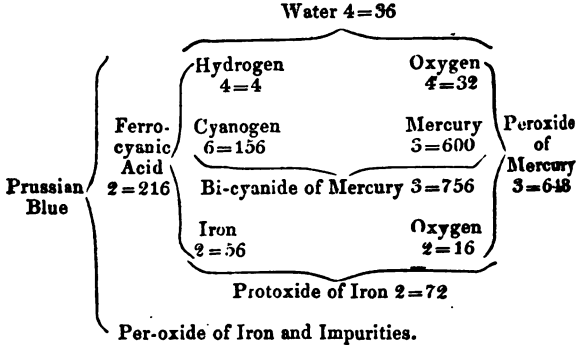


Note.—The proportions in which ferro-cyanic acid and peroxide of iron combine to form Prussian blue have not been accurately determined: on that account I have not affixed its equivalent number in the preceding diagrams.

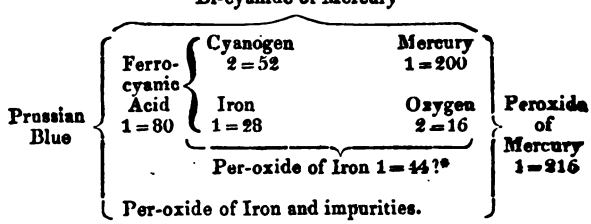
BI-CYANIDE OF MERCURY, ATOMIC WEIGHT 232.

68. When Prussian blue, water, and peroxide of mercury, are boiled together, bi-cyanide of mercury and oxide of iron are formed; the changes which here occur admit of two explanations:—1st. 3 atoms of peroxide of mercury compounded of 6 of oxygen and 3 of mercury are required for the decomposition of 2 of ferro cyanic acid, compounded of 6 of cyanogen, 4 of hydrogen, and 2 of iron; the cyanogen and mercury combine to form bi cyanide of mercury, 4 of oxygen combine with the hydrogen to form water, and the remaining 2 of oxygen combine with the iron to form protoxide of iron, which

remains diffused through the base of the Prussian blue (peroxide of iron) and impurities.



2nd. 1 atom of peroxide of mercury compounded of 1 of mercury and 2 of oxygen, decomposes 1 of ferro-cyanic acid, compounded of 1 atom of iron and 2 of cyanogen; 1 of bi-cyanide of mercury is formed, and 1 of peroxide of iron remains with the base (peroxide of iron) and impurities.



Note.—This decomposition is explained on the supposition that the ferro-cyanic acid is solely compounded of 2 cyanogen + 1 iron.

* *Vide* note to section 80.

CYANOGEN IN THE GASEOUS FORM, ATOMIC WEIGHT 26.

69. On the application of heat to bi-cyanide of mercury, cyanogen escapes, and the vapour of mercury condenses in the cooler part of the retort.

Bi cyanide of Mercury { Cyanogen 2 = 54 escapes / Mercury 1 = 200 } Heat

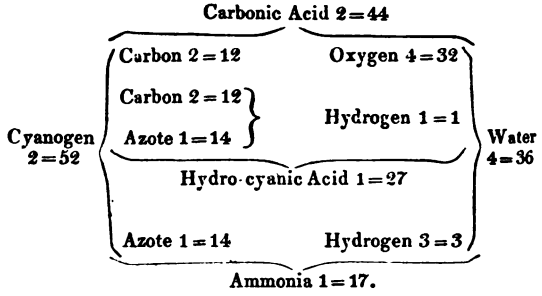
On account of the numerous compounds which cyanogen forms with other matters, I have thought it right to deviate from my usual course by giving a list of them here.

1 cyanogen .... + 1 oxygen ... = 1 cyanous acid..... = 34
1 ditto..... + 2 ditto ..... = 1 cyanic acid ..... = 42
1 ditto..... + 1 chlorine... = 1 cyanide of chlorine .. = 62
1 ditto..... + 2 ditto ..... = 1 per-chloride of cyanogen ..... = 98
1 ditto..... + 1 iodine..... = 1 iodide of cyanogen.. = 150
1 ditto..... + 1 bromine... = 1 bromide of cyanogen = 104 ?
1 ditto..... + 1 hydrogen .. = 1 hydro-cyanic acid .. = 27
1 hydro-cyanic acid.. + 2 sulphur.... = 1 sulpho-cyanic acid .. = 59
1 cyanogen .... + 1 ditto ..... = 1 sulphuret of cyanogen = 42 ?
1 ditto..... + 2 ditto..... = 1 bi-sulphuret of cyanogen ..... = 58
1 ditto..... + ** selenium . = 1 selenio-cyanic acid .. = —
3 ditto..... + 1 iron..... = 1 radicle of ferro-cyanic acid..... = 106
1 radicle of ferro-cyanic acid.. + 2 hydrogen .. = 1 ferro-cyanic acid .... = 108

CHANGE WHICH OCCURS DURING THE ABSORPTION OF CYANOGEN BY POTASSA.

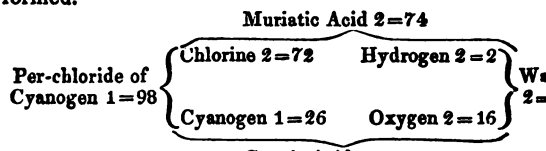
70. When a solution of potassa is made to absorb cyanogen, 4 atoms of water and 2 of cyanogen are de-

composed, 4 of oxygen combine with 2 of carbon to form 2 of carbonic acid, 1 of azote and 3 of hydrogen form 1 of ammonia, 2 of carbon, 1 of azote, and 1 of hydrogen, combine to form 1 of hydro-cyanic acid.



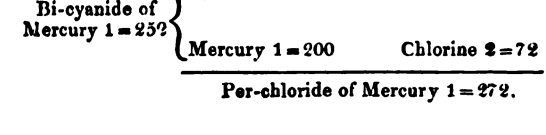
CYANIC ACID, ATOMIC WEIGHT 42.

71. When per-chloride of cyanogen is dissolved in water, 2 atoms of muriatic acid and 1 of cyanic acid are formed.



CYANIDE OF CHLORINE, ATOMIC WEIGHT 62.

72. When moistened bi-cyanide of mercury is exposed to the action of chlorine, 1 atom of per-chloride of mercury and 2 of cyanide of chlorine are formed.



PER-CHLORIDE OF CYANOGEN, ATOMIC WEIGHT 93.

73. When a current of chlorine is passed through real hydro-cyanic acid, muriatic acid and per-chloride of cyanogen result.

Muriatic Acid 1 = 37

Hydro-cyanic Acid 1 = 27 { Hydrogen 1 = 1 Chlorine 1 = 36 / Cyanogen 1 = 26 Chlorine 2 = 72

Per-chloride of Cyanogen 1 = 98.

HYDRO-CYANIC ACID, ATOMIC WEIGHT 27.

First Process.

74. Both the muriatic acid and bi-cyanide of mercury suffer decomposition; the chlorine combines with the mercury to form bi-chloride, and the cyanogen with the hydrogen to form hydro-cyanic acid.

Hydro-cyanic Acid 2 = 54

Muriatic Acid 2 = 74 { Hydrogen 2 = 2 Cyanogen 2 = 52 / Chlorine 2 = 72 Mercury 1 = 200 } Bi-cyanide of Mercury 1 = 252

Per-chloride of Mercury 1 = 272.

HYDRO-CYANIC ACID.

Second Process.

75. When a current of sulphuretted hydrogen is driven through bi-cyanide of mercury, hydro-cyanic acid and bi-sulphuret of mercury are thus formed:—

Hydro-cyanic Acid 2 = 54

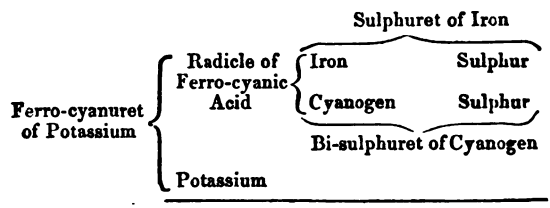
Bi-cyanide of Mercury 1 = 252 { Cyanogen 2 = 52 Hydrogen 2 = 2 / Mercury 1 = 200 Sulphur 2 = 32 } Sulphuretted Hydrogen 2 = 34

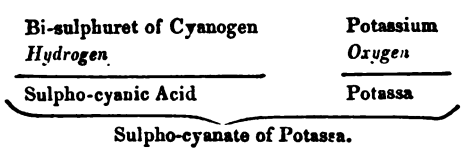
Bi-sulphuret of Mercury 1 = 232.

For an explanation of the changes which occur in testing for hydro-cyanic acid, I refer the reader to sections 66. C. and 67.

SULPHO-CYANATE OF POTASSA.

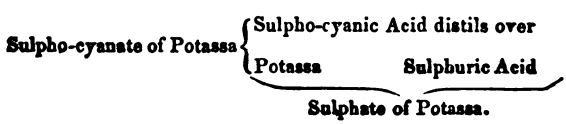
76. Sulphur and ferro-cyanuret of potassium are employed, the iron and cyanogen combine with separate portions of sulphur to form sulphuret of iron and bi-sulphuret of cyanogen, the latter combines with the potassium to form sulpho-cyanuret of potassium, which when dissolved in *water* forms sulpho-cyanate of potassa.





SULPHO-CYANIC ACID, ATOMIC WEIGHT 59.

77. When sulpho-cyanate of potassa and sulphuric acid are heated together, sulphate of potassa is formed and sulpho-cyanic acid distils over.



FERRO-CYANATE OF POTASSA.

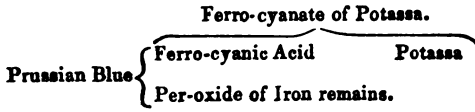
First Process.

78. The changes which occur during the formation of ferro-cyanate of potassa on a large scale are already explained in sections 66 and 67, with this difference however, that a portion of metallic iron (which must be present in the formation of this salt) combines with the cyanide of potassium, to form ferro-cyanide of potassium.

FERRO-CYANATE OF POTASSA.

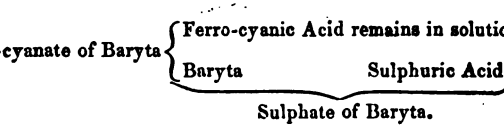
Second Process.

79. Prussian blue and caustic potassa are employed, the potassa combines with the ferro-cyanic acid to form ferro-cyanate of potassa and peroxide of iron is left.



FERRO-CYANIC ACID, ATOMIC WEIGHT 108.

80. On the addition of sulphuric acid to ferro-cyanate of baryta, sulphate of baryta is formed, and ferro-cyanic acid remains in solution.



Note.—Perhaps there is no substance (phosphorus and its compounds excepted) whose composition is wrapt in such obscurity as ferro-cyanic acid. Some chemists state its composition to be 3 atoms of cyanogen =78+2 of hydrogen = 2, and 1 of iron =28, making its atomic weight 108. I have explained the

formation of commercial Prussian blue and bi-cyanide of mercury according to that theory, in sections 66 and 68. 1 ; and, in my opinion, it explains the changes which occur very well. There are other chemists who state its composition to be 2 atoms of cyanogen + 1 of iron : the changes which occur during the formation of Prussian blue and bi-cyanide of mercury are explained thus in sections 67 and 68. 2 : but here there are certain anomalies in the explanation of the changes which are not easily overcome ; the two following examples will suffice :—When proto-sulphate of iron is added to hydro-cyanate of potassa, they will tell you that water and ferro-cyanic acid are formed ; but hydro-cyanic acid is compounded of 1 cyanogen + 1 hydrogen ; protoxide of iron is compounded of 1 iron + 1 of oxygen ; water, one of the products is compounded of 1 oxygen + 1 of hydrogen. It is evident, therefore, that for every atom of water which is formed, 1 atom of cyanogen and 1 of iron must be liberated to form ferro-cyanic acid, contrary to the atomic constitution which they have assigned to it. Again, when Prussian blue and peroxide of mercury are boiled together, they will say that 1 atom of ferro-cyanic acid decomposes 1 of peroxide of mercury ; that 2 of cyanogen combine with 1 of mercury to form a bi-cyanide of mercury ; and the 2 of oxygen which are liberated combine with 1 of iron to form peroxide of iron ; but this is contrary to the assigned composition of peroxide of iron, viz. 1 iron + 1½ oxygen, the explanation is therefore incorrect. These examples are, in my opinion, sufficient to show that the first of these theories is preferable to the second, inasmuch as it satisfactorily explains all the decompositions connected with this subject, in accordance with the atomic numbers assigned to all the substances concerned.

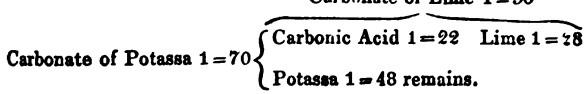
PART V.

THE METALS.

POTASSIUM.

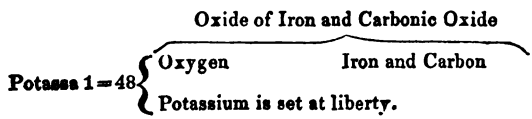
LIQ. POTASSÆ.

81. Lime and sub-carbonate (carbonate) of potassa are employed; the lime combines with the carbonic acid to form carbonate of lime, which is precipitated, leaving caustic potassa in solution.



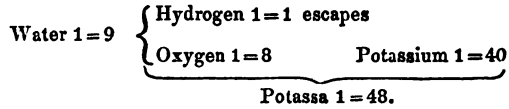
POTASSIUM, ATOMIC WEIGHT 40.

82. When potassa is heated in contact with iron and charcoal, they abstract the oxygen and set the potassium at liberty.



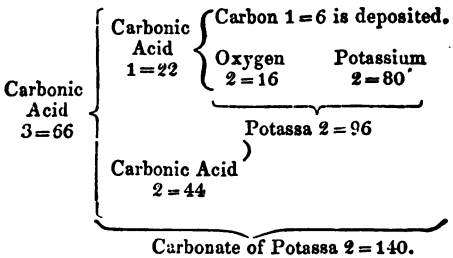
ACTION OF POTASSIUM ON WATER.

83. When potassium is thrown on the surface of water, oxygen combines with the potassium to form potassa; and hydrogen, holding a portion of potassium in solution, is liberated.



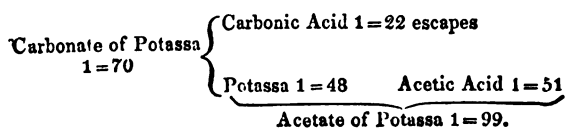
ACTION OF POTASSIUM ON CARBONIC ACID.

84. When potassium is heated in carbonic acid, a portion of carbonic acid is decomposod, potassa is formed, and carbon is deposited, the potassa is combined with another portion of carbonic acid to form carbonate of potassa.



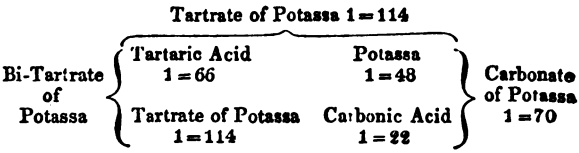
POTASSÆ ACETAS, ATOMIC WEIGHT 99.

85. The acetic acid combines with the potassa, and sets the carbonic acid at liberty.



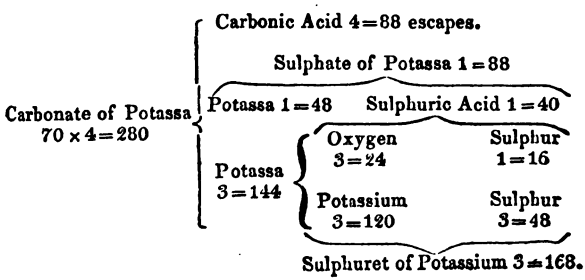
POTASSÆ TARTRAS, ATOMIC WEIGHT 114.

86. Carbonate of potassa is added to a solution of bi-tartrate of potassa until saturation; 1 atom of bi-tartrate combines with 1 of potassa to form 2 of tartrate of potassa, and the carbonic acid escapes.



POTASSÆ SULPHURETUM. P. L.

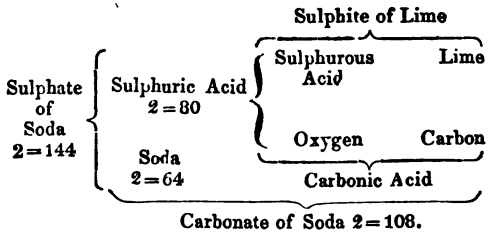
87. When carbonate of potassa and sulphur are heated together, all the carbonic acid escapes, 3 atoms of potassa suffer decomposition; 3 of oxygen combine with 1 of sulphur to form 1 of sulphuric acid, which, with an atom of undecomposed potassa, forms sulphate of potassa. The potassium which results combines with 3 atoms of sulphur to form 3 atoms of sulphuret of potassium; 3 atoms of sulphuret of potassium, and 1 of sulphate of potassa, therefore result, forming the potassæ sulphuretum. P. L.



SODIUM, ATOMIC WEIGHT 24.

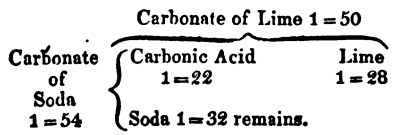
CARBONATE OF SODA, ATOMIC WEIGHT 54.

88. Sulphate of soda, carbon, and lime, are employed; part of the carbonaceous matter decomposes the sulphuric acid, and converts it into sulphurous acid, of which part combines with the lime, and part escapes. Another portion combines with the oxygen of the atmosphere to form carbonic acid, which combines with the soda to form carbonate of soda.



CAUSTIC SODA, ATOMIC WEIGHT 32.

89. When lime is added to carbonate of soda, carbonate of lime is precipitated, and caustic soda remains in solution; which may, by evaporation to dryness, be obtained in a solid form.



SODIUM.

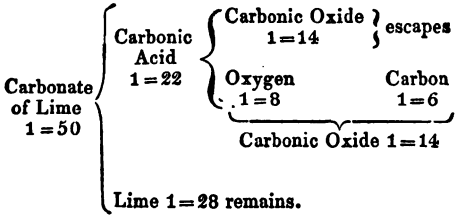
90. An explanation of this decomposition will be found at 82.

In the production of salts having soda for their base, the decompositions are precisely similar to those which occur in the formation of salts having potassa for their base.

CALCIUM, ATOMIC WEIGHT 20.

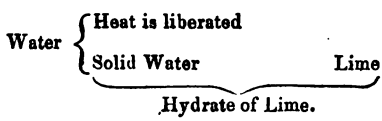
CAUSTIC LIME, ATOMIC WEIGHT 28.

91. When carbonate of lime and charcoal are heated together, the carbonic acid combines with an additional atom of carbon, and escapes in the form of carbonic oxide, leaving the lime in a caustic state.



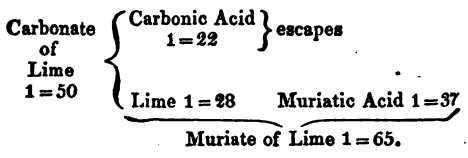
HYDRATE OF LIME, ATOMIC WEIGHT 37.

92. In consequence of the powerful attraction of lime for water, it seizes the water, and liberates the heat essential to fluidification or LATENT HEAT.



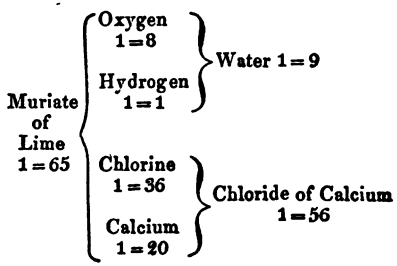
MURIATE OF LIME, ATOMIC WEIGHT 65.

93. Carbonate of lime and muriatic acid are employed; the muriatic acid combines with the lime to form muriate of lime, and carbonic acid escapes.



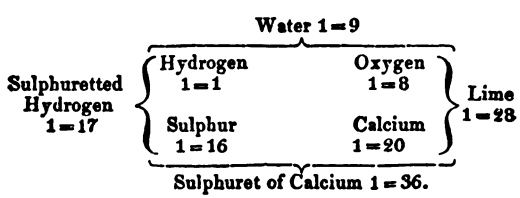
CHLORIDE OF CALCIUM, ATOMIC WEIGHT 56.

94. When muriate of lime is heated to redness, the hydrogen from the muriatic acid, and the oxygen from the lime, combine to form water, leaving chloride of calcium behind.



SULPHURET OF CALCIUM, ATOMIC WEIGHT 36.

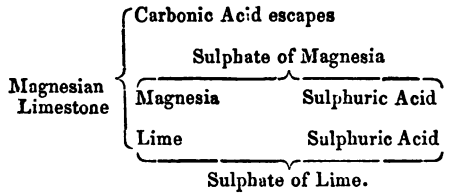
95. When sulphuretted hydrogen is passed over lime heated to redness, the hydrogen combines with the oxygen to form water, leaving the calcium combined with a portion of sulphur to form sulphuret of calcium.



MAGNESIUM, ATOMIC WEIGHT 12.

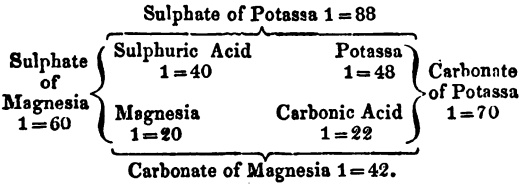
SULPHATE OF MAGNESIA, ATOMIC WEIGHT 60 (DRY).

96. Native magnesian limestone and sulphuric acid are employed; the sulphuric acid combines with the magnesia and lime to form sulphates of magnesia and lime, carbonic acid escapes, oxide of manganese and other impurities remain behind.



CARBONATE OF MAGNESIA, ATOMIC WEIGHT 42.

97. Double decomposition takes place; the carbonic acid combines with the magnesia to form carbonate of magnesia, the sulphuric acid with the potassa to form sulphate of potassa.



MAGNESIA, ATOMIC WEIGHT 20.

98. When carbonate of magnesia is exposed to heat, the carbonic acid escapes in combination with caloric, leaving the pure earth behind.

Carbonate of Magnesia 1=42 { Carbonic Acid 1=22 } escapes — Heat
Magnesia 1=20 remains.

BARIUM, ATOMIC WEIGHT 70.

MURIATE OF NITRATE OF BARYTA.

99. When native carbonate of baryta is digested in either of the above acids, the carbonic acid escapes, and the baryta combines with the acid to form a salt.

Carbonate of Baryta { Carbonic Acid escapes
Baryta — Muriatic or Nitric Acids }
Muriate or Nitrate of Baryta.

BARYTA, ATOMIC WEIGHT 78.

First Process.

100. By the action of heat nitrate of baryta suffers decomposition, the pure earth remains, and the gaseous constituents of nitric acid escape.

Nitrate of Baryta 1=132 { Nitric Acid 1=54 is decomposed.
Baryta 1=78 remains.

BARYTA.

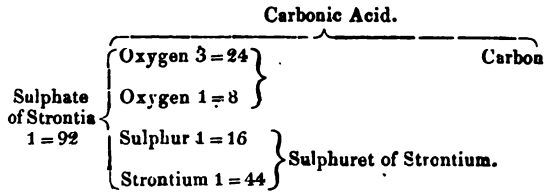
Second Process.

101. For the explanation of this process see Lime, 91.

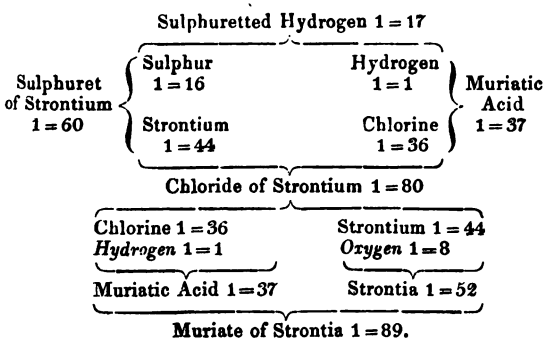
MURIATE OR NITRATE OF STRONTIA.

102. A. Sulphate of strontia, when mixed with charcoal and strongly heated, suffers decomposition; sulphuret of strontium is formed, and the oxygen which results from the decomposition of the sulphuric acid and

strontia combines with the carbon to form carbonic acid, which escapes.

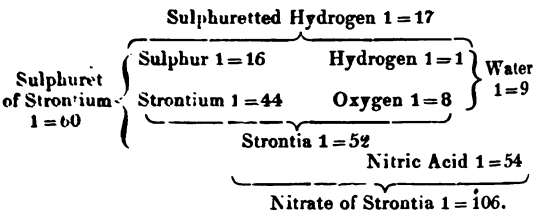


103. B. When sulphuret of strontium is dissolved in diluted muriatic acid, the strontium combines with the chlorine to form chloride of strontium, which immediately decomposes the *water*, and forms muriate of strontia; while the sulphur combines with the hydrogen to form sulphuretted hydrogen, which escapes.


Sulphuretted Hydrogen 1 = 17
Sulphuret of Strontium 1 = 60
Sulphur 1 = 16
Hydrogen 1 = 1
Strontium 1 = 44
Chlorine 1 = 36
Muriatic Acid 1 = 37
Chloride of Strontium 1 = 80
Chlorine 1 = 36
Hydrogen 1 = 1
Strontium 1 = 44
Oxygen 1 = 8
Muriatic Acid 1 = 37
Strontia 1 = 52
Muriate of Strontia 1 = 89.

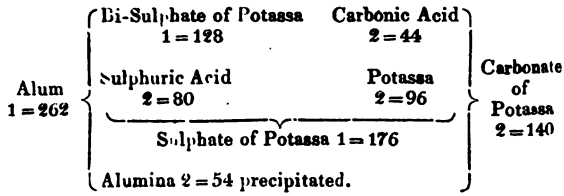
104. C. If nitric acid be used instead of muriatic acid, the water then suffers decomposition, the oxygen combines with the strontium to form strontia; and this, with the nitric acid, forms nitrate of strontia; while the hy-

drogen combines with the sulphur to form sulphuretted hydrogen, which escapes.


Sulphuretted Hydrogen 1 = 17
Sulphur 1 = 16
Hydrogen 1 = 1
Water 1 = 9
Sulphuret of Strontium 1 = 60
Strontium 1 = 44
Oxygen 1 = 8
Strontia 1 = 52
Nitric Acid 1 = 54
Nitrate of Strontia 1 = 106.

ALUMINA, ATOMIC WEIGHT 27.

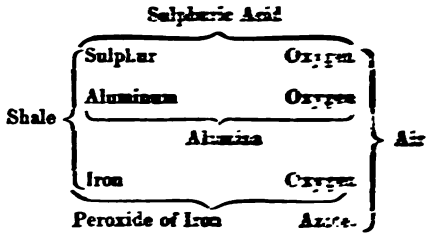
105. When carbonate of potassa is added to a solution of alum, alumina is precipitated, carbonic acid escapes, and the potassa combines with the excess of sulphuric acid to form sulphate of potassa.


Bi-Sulphate of Potassa 1 = 128
Carbonic Acid 2 = 44
Alum 1 = 262
Sulphuric Acid 2 = 80
Potassa 2 = 96
Carbonate of Potassa 2 = 140
Sulphate of Potassa 1 = 176
Alumina 2 = 54 precipitated.

ALUM, ATOMIC WEIGHT 262 (DRY).

106. Shale, or alum ore, is compounded of sulphuret of iron and aluminum. When submitted to the operation of roasting, alumina and per-oxide of iron are formed, part of the sulphur escapes, and the remainder combines with oxygen from the atmosphere to form sulphuric acid,

which combines with the alumina to form sulphate of alumina.

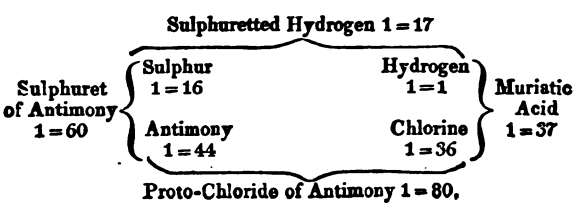


PROPER METALS.

ANTIMONY, ATOMIC WEIGHT 44.

PROTO-CHLORIDE OF ANTIMONY, ATOMIC WEIGHT 80.

107. When sulphuret of antimony and muriatic acid are heated together, the metal combines with the chlorine to form proto-chloride of antimony; the sulphur combines with the hydrogen to form sulphuretted hydrogen, which escapes.



171

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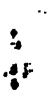
CHEMICAL DIAGRAMS.



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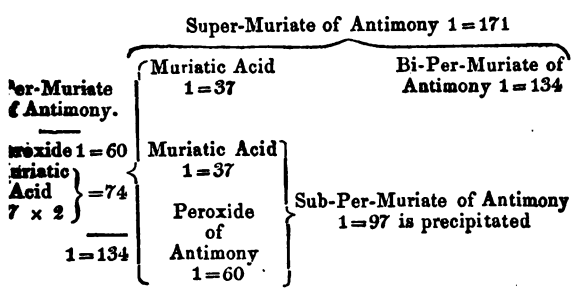
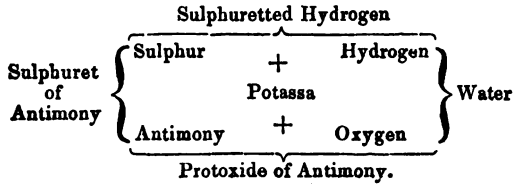
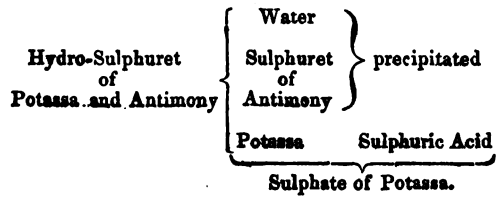

Super-Muriate of Antimony 1=171
Muriatic Acid 1=37
Bi-Per-Muriate of Antimony 1=134
Muriatic Acid 1=37
Peroxide of Antimony 1=60
Sub-Per-Muriate of Antimony 1=97 is precipitated

ANTIMONII SULPHURETUM PRÆCIPITATUM.

111. A. When sulphuret of antimony and solution of potassa are boiled together, the water suffers decomposition, the hydrogen combines with the sulphur, and the oxygen with the antimony, both of which are held in solution by the potassa.

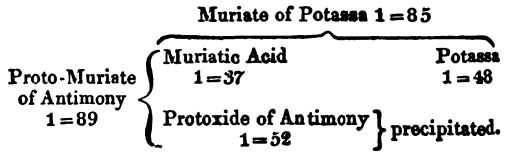


112. B. When sulphuric acid is added to the above solution, sulphate of potassa is formed, a little sulphuretted hydrogen escapes, while hydrated sulphuret of antimony with excess of sulphur is precipitated.



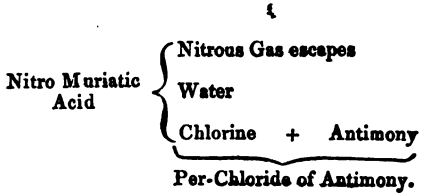
PROTOXIDE OF ANTIMONY, ATOMIC WEIGHT 52.

108. When a solution of potassa is added to one containing proto-muriate of antimony, the potassa combines with the muriatic acid, and sets the protoxide of antimony at liberty.

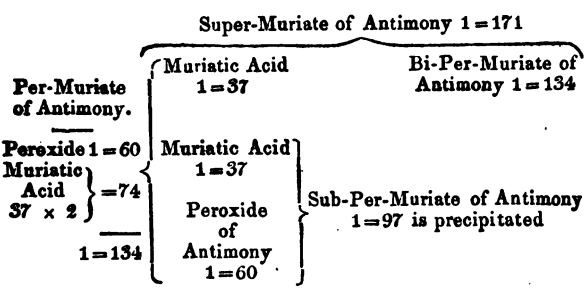


BI-PER-MURIATE OF ANTIMONY, ATOMIC WEIGHT 134.

109. The chlorine from the nitro-muriatic acid combines with the antimony to form per-chloride of antimony; which immediately decomposes the water to form a per-muriate of antimony; at the same time water and nitrous gas are formed by the mutual action of the nitric and muriatic acids.

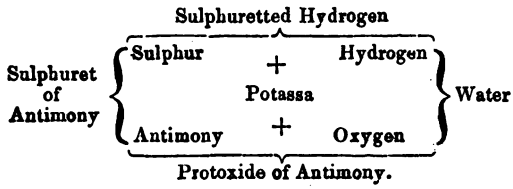


110. When a solution of antimony is poured into water, a sub-salt is precipitated; and the excess of acid combines with another portion, to hold it in solution.

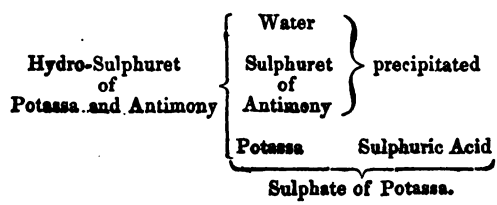


ANTIMONII SULPHURETUM PRÆCIPITATUM.

111. A. When sulphuret of antimony and solution of potassa are boiled together, the water suffers decomposition, the hydrogen combines with the sulphur, and the oxygen with the antimony, both of which are held in solution by the potassa.

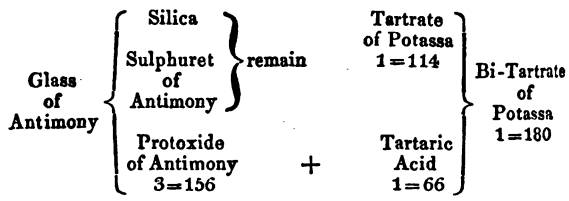


112. B. When sulphuric acid is added to the above solution, sulphate of potassa is formed, a little sulphuretted hydrogen escapes, while hydrated sulphuret of antimony with excess of sulphur is precipitated.



ANTIMONIUM TARTARISATUM, P. L., ATOMIC WEIGHT 363.

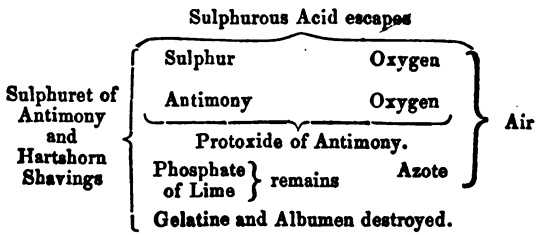
113. Glass of antimony, bi-tartrate of potassa, and water, are boiled together; the protoxide of antimony combines with the bi-tartrate to form a double salt, leaving a little sulphuret of antimony and silica untouched.



Tartrate of Antimony and Potassa 1=336 (DRY).

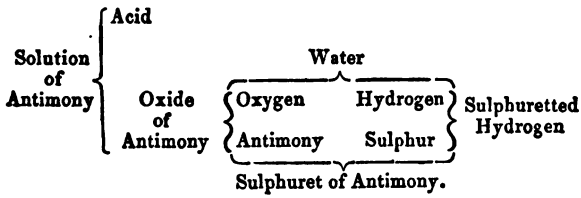
PULVIS ANTIMONIALIS. P. L.

114. When sulphuret of antimony and hartshorn shavings are heated together, the sulphur is expelled; and the antimony combines with oxygen from the air, to form protoxide of antimony, at the same time the animal matter is wholly decomposed: phosphate of lime and protoxide of antimony result. By a further application of heat, the protoxide is converted into per-oxide.



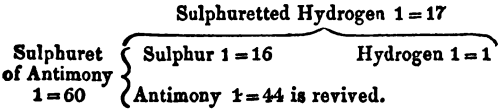
115. When sulphuretted hydrogen is driven through a solution of antimony, the sulphur combines with the

metal to form a sulphuret, leaving oxygen and hydrogen to form water.



REDUCTION OF SULPHURET OF ANTIMONY.

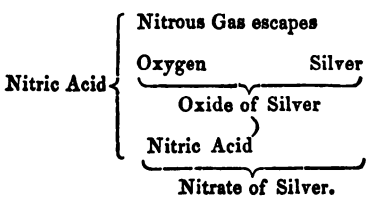
116. When hydrogen gas is passed over sulphuret of antimony, the sulphur combines with the hydrogen to form sulphuretted hydrogen, which escapes, and metallic antimony remains.



SILVER, ATOMIC WEIGHT 110.

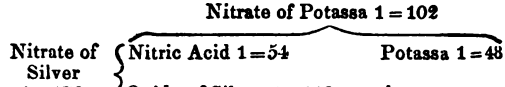
NITRATE OF SILVER, ATOMIC WEIGHT 1 = 172.

117. The nitric acid suffers decomposition, nitrous gas escapes, and the oxygen combines with the silver to form oxide of silver, which is dissolved by another portion of nitric acid to form nitrate of silver.



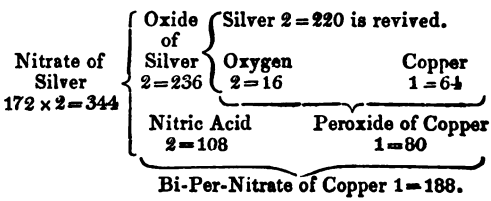
OXIDE OF SILVER, ATOMIC WEIGHT 118.

118. When any pure alkali is added to a solution of nitrate of silver, oxide of silver is precipitated, and the nitric acid combines with the alkali to form a salt.



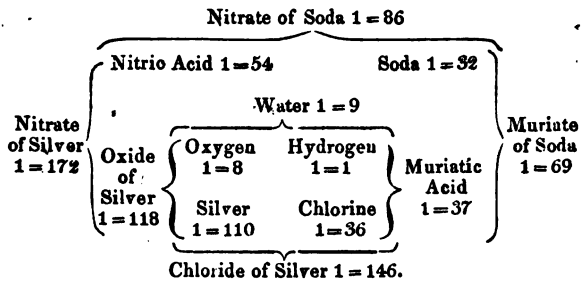
ACTION OF COPPER ON A SOLUTION OF SILVER.

119. When a piece of metallic copper is placed in a solution of nitrate of silver, nitrate of copper is formed, and metallic silver is precipitated.


Nitrate of Silver 172 x 2 = 344
Oxide of Silver 2 = 236
Silver 2 = 220 is revived.
Oxygen 2 = 16
Copper 1 = 64
Nitric Acid 2 = 108
Peroxide of Copper 1 = 80
Bi-Per-Nitrate of Copper 1 = 188.

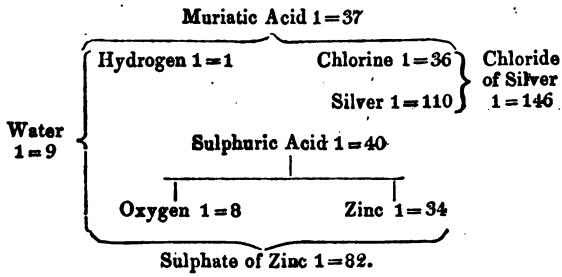
CHLORIDE OF SILVER, ATOMIC WEIGHT 146.

120. When a solution of muriate of soda is added to a solution of silver, the chlorine combines with the silver, and the hydrogen with the oxygen; the soda then combines with the nitric acid to form nitrate of soda.



REDUCTION OF CHLORIDE OF SILVER.

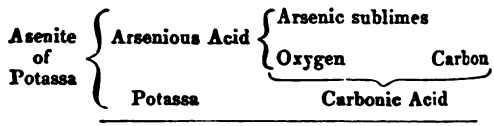
121. Moist chloride of silver, zinc, and sulphuric acid, are employed; the water is decomposed; its hydrogen, at the moment of liberation, combines with the chlorine to form muriatic acid, leaving metallic silver in its place: at the same time the oxygen combines with the zinc to form oxide of zinc, which, with the sulphuric acid, forms a sulphate of zinc.



ARSENICUM, ATOMIC WEIGHT 38.

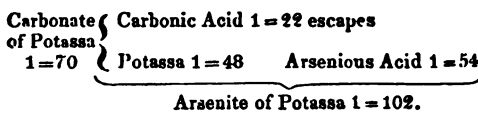
122. Arsenious acid and black flux are employed. In the first place arsenite of potassa is formed; and, se-

condly, the charcoal decomposes this arsenite, forming carbonate of potassa and metallic arsenic.



LIQ. ARSENICALIS. P. L.

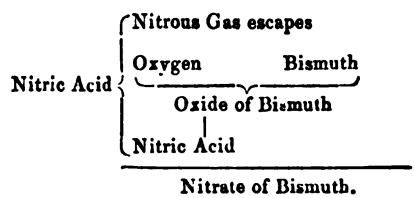
123. The arsenious acid combines with the potassa, and sets the carbonic acid at liberty: the products are arsenite and excess of carbonate of potassa.



BISMUTH, ATOMIC WEIGHT 72.

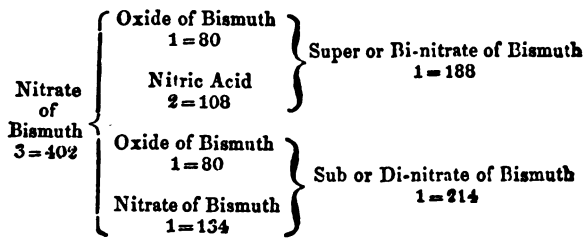
NITRATE OF BISMUTH, ATOMIC WEIGHT 134.

124. When nitric acid and bismuth are heated together, part of the nitric acid suffers decomposition; its oxygen combines with the bismuth to form an oxide, which combines with another portion of nitric acid to form a nitrate of bismuth, and nitrous gas escapes.



SUBNITRATE OF BISMUTH.

125. In preparing this substance, 2 atoms of nitrate of bismuth suffer decomposition, 2 atoms of oxide are precipitated, in combination with 1 of nitric acid; while the remaining atom of nitric acid combines with another portion of nitrate of bismuth to form bi-nitrate of bismuth.


Nitrate of Bismuth 3=402
Oxide of Bismuth 1=80
Nitric Acid 2=108
Super or Bi-nitrate of Bismuth 1=188
Oxide of Bismuth 1=80
Nitrate of Bismuth 1=134
Sub or Di-nitrate of Bismuth 1=214

COPPER, ATOMIC WEIGHT 64.

SULPHATE OF COPPER, ATOMIC WEIGHT 160.

126. I. For the production of bi-sulphate of copper (blue vitriol), copper pyrites are heated to redness in contact with the air. Copper pyrites are compounded of sulphur 2 atoms = 32 + 1 of copper = 64; the copper combines with the *oxygen* of the *air* to form peroxide of copper; the sulphur also combines with oxygen to form sulphuric acid; the two then combine to form bi-sulphate of copper.

Sulphuret of Copper 1=96

Sulphur 2=32	Copper 1=64
Oxygen 6=48	Oxygen 2=16
Sulphuric Acid 2=80	Peroxide of Copper 1=80

Bi-per-sulphate of Copper (Blue Vitriol) 1=160.

Note.—The same decomposition takes place in the production of green vitriol (proto-sulphate of iron) and white vitriol (sulphate of zinc), for commercial purposes.

SULPHATE OF COPPER.

127. II. When sulphuric acid and copper are heated together, one atom of copper seizes 2 of oxygen, consequently 2 of sulphuric acid are decomposed; at the same time 2 atoms of sulphurous acid are liberated, the peroxide of copper then combines with two additional atoms of sulphuric acid to form a bi-per-sulphate of copper.

Sulphuric Acid 4=160

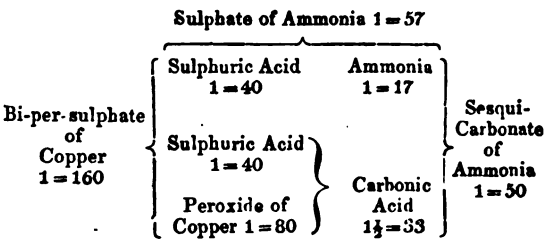
Copper 1=64	Oxygen 2=16	Sulphuric Acid 2=80	Sulphurous Acid 2=64 } escapes

Peroxide of Copper 1=80

Bi-per-sulphate of Copper 1=160.

CUPRUM AMMONIATUM.

128. When sulphate of copper and carbonate of ammonia are triturated together, the carbonic acid escapes: the ammonia then seizes a part of the sulphuric, and forms sulphate of ammonia and sub-sulphate of copper.

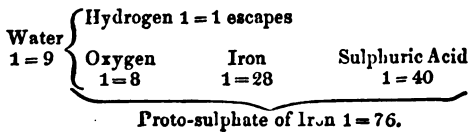

Sulphate of Ammonia 1 = 57
Sulphuric Acid 1 = 40
Ammonia 1 = 17
Bi-per-sulphate of Copper 1 = 160
Sesqui-Carbonate of Ammonia 1 = 50
Sulphuric Acid 1 = 40
Carbonic Acid 1½ = 33
Peroxide of Copper 1 = 80

Note.—The preceding explanation is that most usually given; but I think it very probable, on account of the large quantity of ammonia used, and the ammoniacal odour of the salt, that the whole of the sulphuric acid is neutralized by ammonia; and the peroxide of copper thus set free, combines with an excess of ammonia to form per-ammonuret of copper.

IRON, ATOMIC WEIGHT 28.

PROTO-SULPHATE OF IRON, ATOMIC WEIGHT 76.

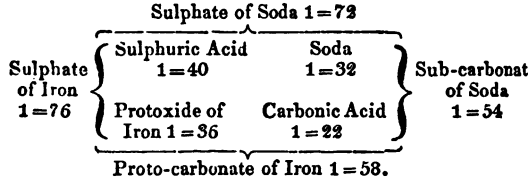
129. Iron and dilute sulphuric acid are employed; the water suffers decomposition, its oxygen unites with the iron and sulphuric acid to form proto-sulphate of iron, and hydrogen gas escapes.



FERRI SUB-CARBONAS. P. L.

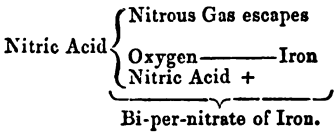
130. Sulphate of iron and sub-carbonate of soda are used; the sulphuric acid combines with the soda, and the carbonic with the protoxide of iron, which is precipitated

at first green, and is in fact a true proto-carbonate of iron; but, during the process of drying more oxygen is absorbed, and nearly all the carbonic acid escapes.

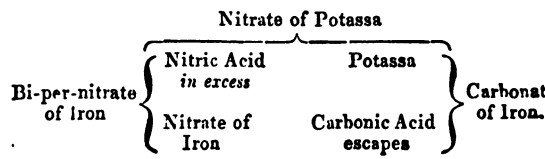


LIQUOR FERRI ALKALINI.

131. A. By the action of nitric acid on metallic iron per-nitrate of iron is formed, and nitrous gas escapes.



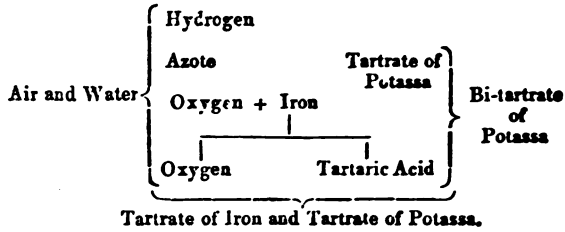
131. B. When a solution of per-nitrate of iron is added to one containing carbonate of potassa, the excess of acid combines with the potassa, and sets the carbonic acid free: the solution contains neutral nitrate of iron and potassa.



FERRUM TARTARIZATUM.

132. Iron, super-tartrate of potassa, and water, are exposed to the air for several days; the iron is per-

oxidised at the expense of the air and water: this combines with the super-tartrate of potassa to form a double salt; and at the same time hydrogen and azotic gas escapes.



MERCURY, ATOMIC WEIGHT 200.

PER AND PRO-NITRATE OF MERCURY.

This decomposition is already explained at 124—(NITRATE OF BISMUTH).

NITRIC OXIDE OF MERCURY, ATOMIC WEIGHT 216.

133. By the action of heat, per-nitrate of mercury is entirely resolved into peroxide of mercury and nitric acid, which escapes in the form of red vapours.

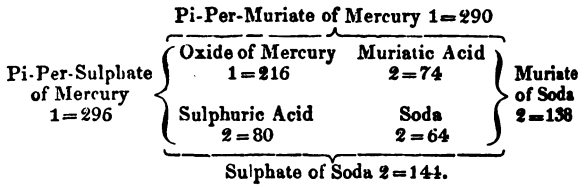
Per-Nitrate of Mercury { Nitric Acid escapes; Peroxide of Mercury remains.

PER-CHLORIDE OF MERCURY, ATOMIC WEIGHT 272.

134. A. When mercury is boiled in strong sulphuric acid, 1 atom of bi-per-sulphate of mercury is formed, and 2 atoms of sulphurous acid escape.—*Vide* 36.

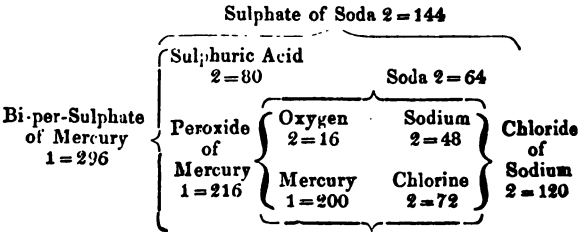
PER-CHLORIDE OF MERCURY, ACCORDING TO THE OLD THEORY.

134. B. I. Bi-per-sulphate of mercury and muriate of soda are employed; the muriatic acid combines with the oxide of mercury to form bi-per-muriate of mercury; the sulphuric acid combines with the soda to form sulphate of soda.



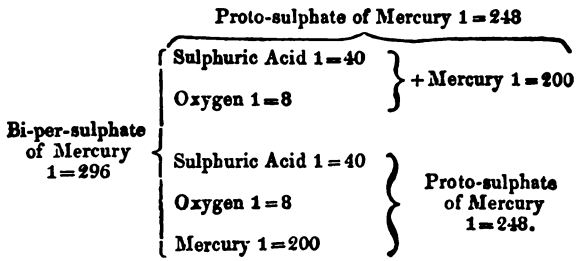
PER-CHLORIDE OF MERCURY, ACCORDING TO THE NEW THEORY.

134. B. II. Bi-per-sulphate of mercury and chloride of sodium are employed; 2 atoms of the latter suffer decomposition; 2 of chlorine = 72 unite with 1 of mercury = 200 to form 1 of per-chloride of mercury = 272, which sublimes: the sodium then combines with 2 of oxygen, from the peroxide of mercury, to form 2 of soda, which unites with the sulphuric acid to form 2 of sulphate of soda, = 144, which remains.

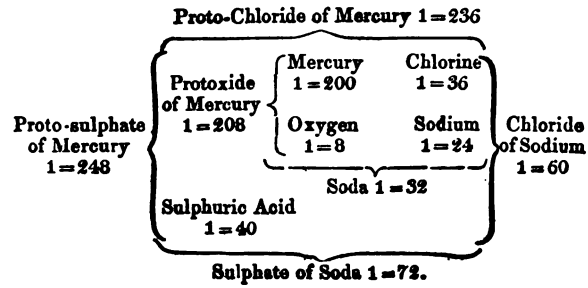


PROTO-CHLORIDE OF MERCURY, ATOMIC WEIGHT 236.

135. A. When bi-per-sulphate of mercury is triturated with a portion of mercury, a division of the oxygen and acid occurs, and the whole is converted into 2 atoms of proto-sulphate of mercury.



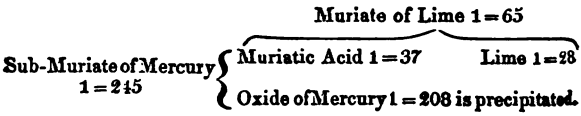
B. When proto-sulphate of mercury is heated with chloride of sodium, 1 atom of each suffers decomposition; 1 of chlorine = 36 combines with 1 of mercury = 200 to form 1 = 236 of proto-chloride of mercury (calomel); 1 of oxygen combines with 1 of sodium to form soda, which combines with the sulphuric acid to form sulphate of soda.



PROTOXIDE OF MERCURY, ATOMIC WEIGHT 208.

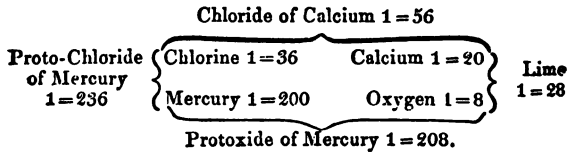
I. *According to the old theory.*

136. Lime-water and calomel are employed; the lime combines with the muriatic acid, and protoxide of mercury is left behind.



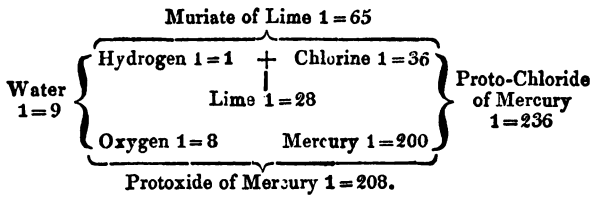
II. *According to Mr. Brande's theory.*

136. The lime suffers decomposition; its oxygen combines with the mercury to form protoxide of mercury, and the chlorine with the calcium to form a chloride of calcium; which immediately decomposes the water to form muriate of lime.



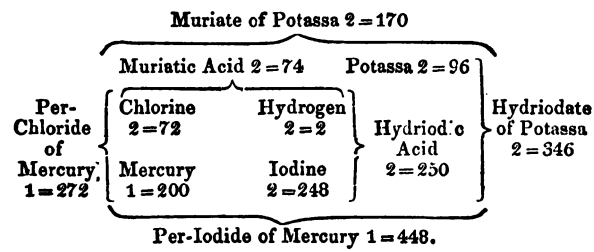
III. *The most usual explanation.*

136. The water suffers decomposition; its oxygen combines with the mercury to form protoxide of mercury, and the hydrogen with the chlorine to form muriatic acid, which combines with the lime to form muriate of lime.



PER-IODIDE OF MERCURY, ATOMIC WEIGHT 448.

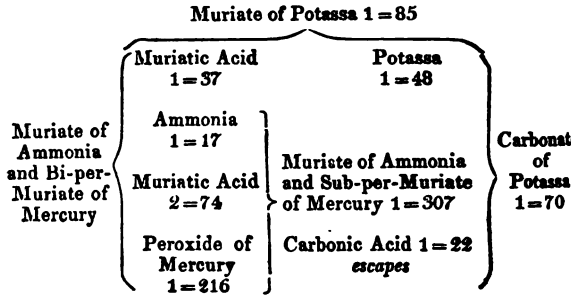
137. When a solution of hydriodate of potassa is added to one containing per-chloride of mercury, 2 atoms of iodine combine with 1 of mercury to form a per-iodide of mercury; at the same time 2 of chlorine combine with 2 of hydrogen to form 2 of muriatic acid, which remains in combination with the potassa.



WHITE PRECIPITATED MERCURY.

138. A solution of per-chloride of mercury in muriate of ammonia, and carbonate of potassa, are employed: when the carbonate of potassa is added, a precipitate is formed, compounded of 1 atom of peroxide of mercury = 216, 1 of ammonia = 17, and 2 of muriatic acid

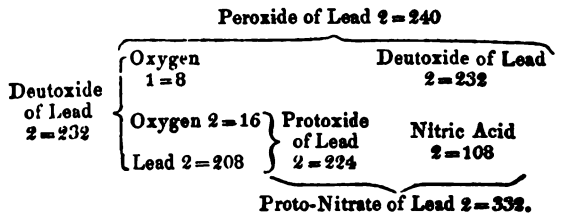
= 74; the remaining atom of muriatic acid combines with the potassa, and sets the carbonic acid free.


Muriate of Potassa 1=85
Muriatic Acid 1=37
Potassa 1=48
Muriate of Ammonia and Bi-per-Muriate of Mercury
Ammonia 1=17
Muriatic Acid 2=74
Peroxide of Mercury 1=216
Muriate of Ammonia and Sub-per-Muriate of Mercury 1=307
Carbonic Acid 1=22 escapes
Carbonate of Potassa 1=70

LEAD, ATOMIC WEIGHT 104.

ACTION OF NITRIC ACID ON DEUTOXIDE OF LEAD.

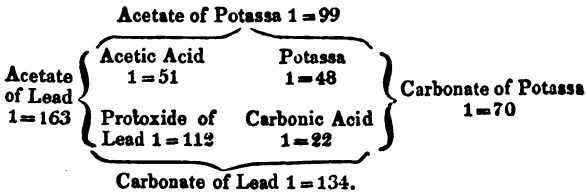
139. When deutoxide of lead (minium) is added to dilute nitric acid, 2 atoms of deutoxide lose 1 of oxygen, and are converted into protoxide, which is taken into solution by the nitric acid: the oxygen then combines with 2 additional atoms of deutoxide to form peroxide, which is precipitated.



CARBONATE OF LEAD, ATOMIC WEIGHT 134.

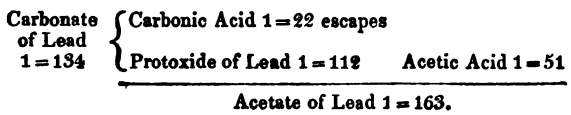
140. Carbonate of potassa is added to a salt of lead,

the carbonic acid combines with the oxide of lead to form carbonate of lead (flake white); at the same time the potassa combines with the acid which held the lead in solution.


Acetate of Potassa 1 = 99
Acetic Acid 1 = 51
Potassa 1 = 48
Acetate of Lead 1 = 163
Protoxide of Lead 1 = 112
Carbonic Acid 1 = 22
Carbonate of Potassa 1 = 70
Carbonate of Lead 1 = 134.

ACETATE OF LEAD, ATOMIC WEIGHT 163.

141. Carbonate of lead and strong acetic acid are employed: the oxide of lead combines with the acetic acid to form an acetate of lead, and the carbonic acid escapes.



ZINC, ATOMIC WEIGHT 34.

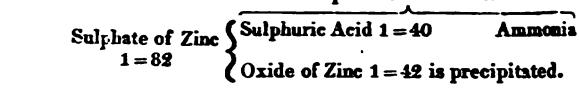
SULPHATE OF ZINC, ATOMIC WEIGHT 82. (DRY.)

142. The decomposition which occurs here is precisely similar to that which occurs in the formation of the ferri sulphas (129).

OXIDE OF ZINC, ATOMIC WEIGHT 42.

143. On the addition of liq. ammonia to a solution of

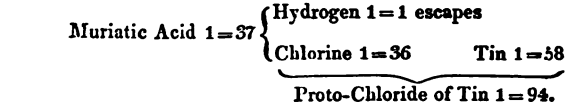
sulphate of zinc, oxide of zinc is precipitated, and sulphate of ammonia remains in solution.



TIN, ATOMIC WEIGHT 58.

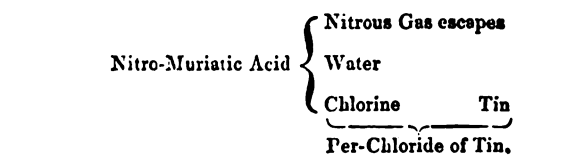
PROTO-MURIATE OF TIN, ATOMIC WEIGHT 103.

144. When strong muriatic acid is digested on tin filings, the chlorine combines with the tin to form a proto-chloride, which immediately decomposes the water to form a proto-muriate of tin, and the hydrogen escapes.



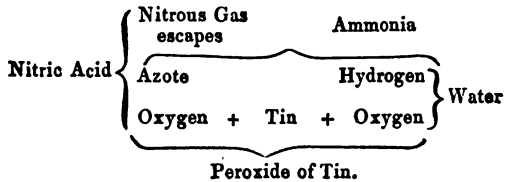
NITRO-MURIATE OF TIN.

145. When tin is acted on by nitro-muriatic acid, the chlorine combines with the tin to form a per-chloride; water is formed by the union of oxygen from the nitric, and hydrogen from the muriatic acids; nitrous gas escapes, and the per-chloride, by decomposition of water, is converted into a per-muriate of tin.



ACTION OF TIN ON NITRIC ACID.

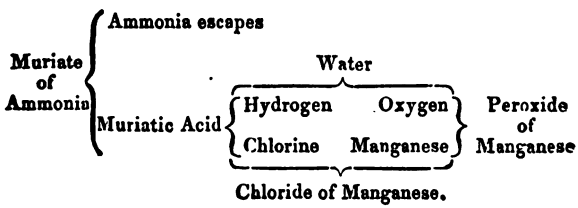
146. When nitric acid is poured on metallic tin, both the nitric acid and its water suffer decomposition; the tin takes oxygen from both to form peroxide of tin; the hydrogen resulting from the decomposition of the water combines with a portion of azote, resulting from the decomposition of the nitric acid, to form ammonia; at the same time a large quantity of nitrous gas escapes.



MANGANESE, ATOMIC WEIGHT 28.

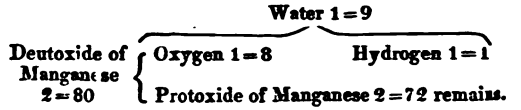
PURIFICATION OF PEROXIDE OF MANGANESE.

147. When peroxide of manganese and muriate of ammonia are heated together, both suffer complete decomposition; the chlorine combines with the metal to form a chloride of manganese; the oxygen and hydrogen then unite to form water, which escapes with the ammonia.



PROTOXIDE OF MANGANESE, ATOMIC WEIGHT 36.

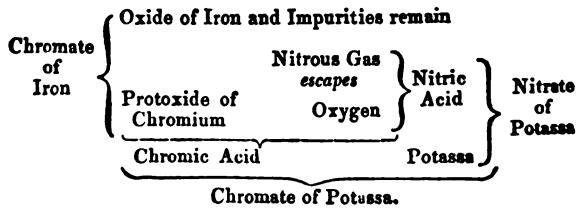
148. When hydrogen gas is passed over heated deutoxide of manganese, it combines with a portion of oxygen from the deutoxide to form water, which escapes, leaving protoxide of manganese.



CHROMIUM, ATOMIC WEIGHT 32.

CHROMATE OF POTASSA, ATOMIC WEIGHT 100.

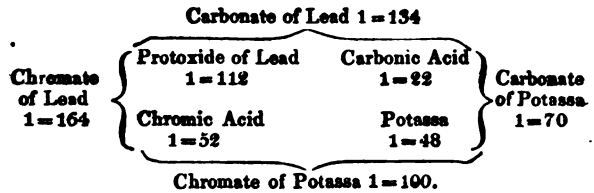
149. I. When chromate of iron (improperly so called), consisting of the protoxides of iron and chromium, is deflagrated with nitrate of potassa, the nitric acid gives a portion of oxygen to the protoxide of chromium, to form chromic acid, which remains in combination with the potassa, while nitrous gas escapes; the oxide of iron and other impurities remain mixed with the chromate of potassa, from which the latter may be separated by lixiviation.



CHROMATE OF POTASSA.

150. II. When carbonate of potassa and chromate of

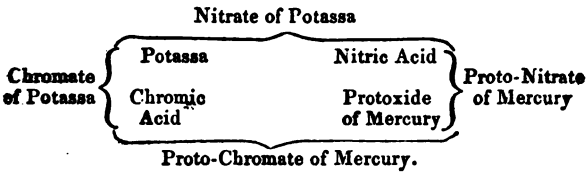
lead are boiled together, chromate of potassa and carbonate of lead are formed.



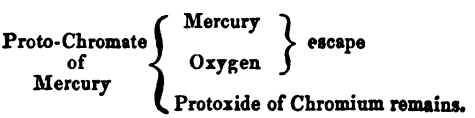
ANHYDROUS PROTOXIDE OF CHROMIUM,

ATOMIC WEIGHT 40.

150. A. When solutions of proto-nitrate of mercury and chromate of potassa are mixed together, proto-chromate of mercury and nitrate of potassa are formed.



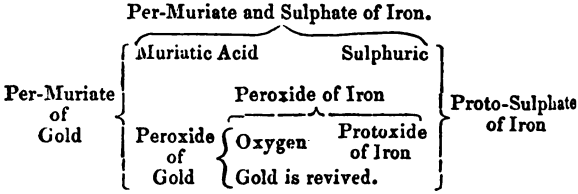
150. B. On the application of heat, the proto-chromate of mercury is completely decomposed, oxygen and metallic mercury are liberated, and protoxide of chromium is left.



GOLD, ATOMIC WEIGHT 200.

REDUCTION TO THE METALLIC STATE BY PROTO-SULPHATE OF IRON.

151. On the addition of a proto-salt of iron to the per-muriate of gold, the gold is revived, and per-muriate and sulphate of iron result.



Note. = Sulphurous acid, phosphorous acid, phosphuretted hydrogen, and many other substances of a similar kind, act in the same manner.

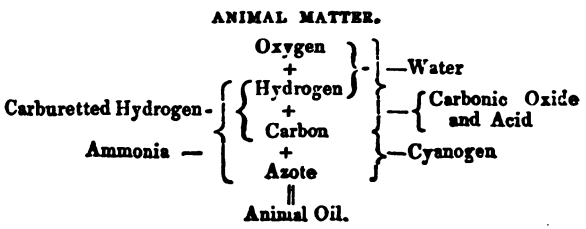
The remainder of the metals having little comparative interest, and the decompositions which occur during their investigation being similar to many which have been already described, will, I trust, be a sufficient excuse for their omission.

PART VI.

VEGETABLE AND ANIMAL CHEMISTRY.

Products formed during the destructive distillation of Animal Matter.

152. When any animal matter, glue for example, is heated in close vessels, portions of hydrogen and oxygen combine to form water, portions of oxygen and carbon unite to form carbonic oxide and acid, portions of hydrogen and carbon combine to form carburetted hydrogen, portions of hydrogen and azote combine to form ammonia, portions of carbon and azote combine to form cyanogen; and lastly, portions of all the elements combine to form a portion of animal oil.



Products formed during the destructive distillation of Vegetable Matter.

153. When any vegetable matter, consisting of oxygen, hydrogen, and carbon, is heated in close vessels, water, carbonic oxide and acid, and carburetted hydrogen, at the same time acetic acid, contaminated with a little empyreumatic oil, is formed by combination between portions of all three elements.

VEGETABLE MATTER.

Carbonic Oxide and Acid { Oxygen + Hydrogen } Water; + Carbon } Carburetted Hydrogen

‖

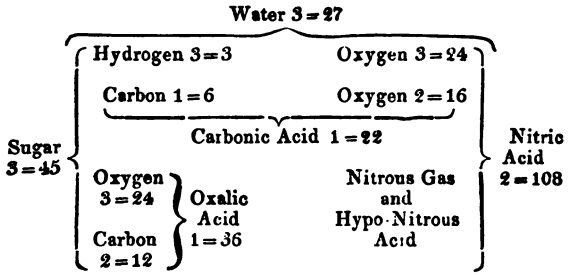
Impure Acetic Acid.

VEGETABLE ACIDS.

OXALIC ACID, ATOMIC WEIGHT 36. (DRY.)

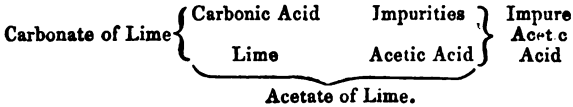
154. In the production of oxalic acid, sugar and nitric acid are employed; 3 atoms of sugar, consisting of 3 atoms of carbon, 3 of oxygen, and 3 of hydrogen, decompose 2 of nitric acid, 3 of hydrogen, and 1 of carbon; rob the nitric acid of a sufficient quantity of oxygen to form water and carbonic acid; at the same time nitrous gas and hypo-nitrous acid escape; 2 atoms of carbon

and 3 of oxygen that remain form 1 atom of oxalic acid = 36.

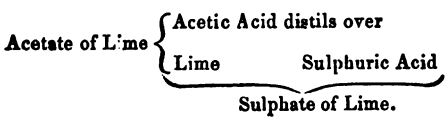


ACETIC ACID, ATOMIC WEIGHT 51.

154. A. To the impure acetic acid obtained by the destructive distillation of wood, technically called pyroligneous acid, carbonate of lime is added, acetate of lime is formed, carbonic acid escapes, and all the impurities contained in the acetic acid are got rid of.



B. On the addition of sulphuric acid to the acetate of lime so formed, sulphate of lime results, and free acetic acid distils over.

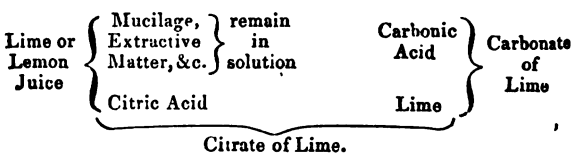


Note.—The atomic weight of acetic acid was formerly stated to

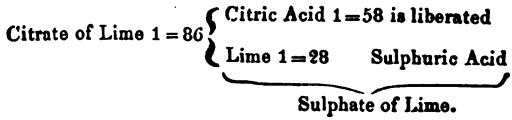
be 50, but according to some experiments lately made by Dr. Prout, the oxygen and hydrogen are inferred to be in the proportions necessary for the formation of water; in that case an additional atom of hydrogen must be added, which would make the atomic weight 51.

CITRIC ACID, P. L. ATOMIC WEIGHT 58.

155. A. Lime or lemon juice contains a considerable portion of citric acid; besides which it also contains mucilage and other matters: when carbonate of lime is added, the carbonic acid escapes, and the lime combines with the citric acid to form an insoluble citrate of lime.



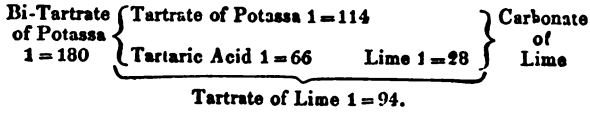
B. When citrate of lime is mixed with dilute sulphuric acid, the citric acid is liberated, and the lime combines with the sulphuric acid to form sulphate of lime.



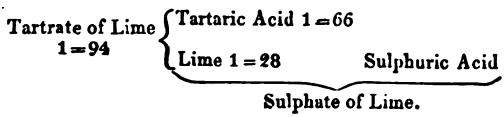
TARTARIC ACID, P. L., ATOMIC WEIGHT 66.

156. A. Bi-tartrate of potassa and carbonate of lime are employed; the excess of tartaric acid combines with

the lime, and sets the carbonic acid at liberty; tartrate of potassa remains in solution.



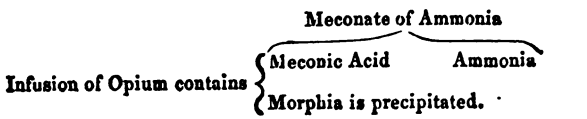
B. On the addition of sulphuric acid, sulphate of lime is formed, and tartaric acid is set at liberty.



VEGETABLE ALKALIES.

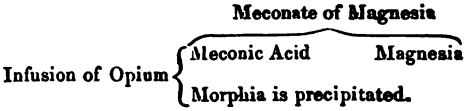
MORPHIA, ACCORDING TO DR. THOMSON.

157. A strong infusion of opium and liquor ammoniæ are employed: on the addition of the ammonia pure morphia is precipitated; the ammonia at the same time combines with the meconic acid to form a soluble meconate of ammonia.



MORPHIA, ACCORDING TO ROBIQUET.

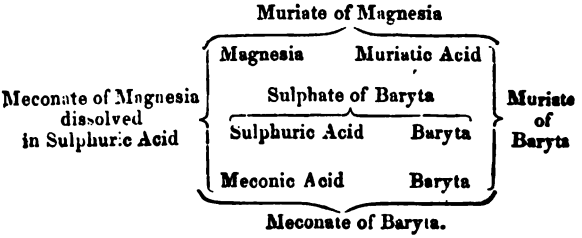
Magnesia and a strong solution of opium are employed; morphia is precipitated, and the meconic acid combines with the magnesia to form meconate of magnesia; the precipitate, therefore, contains morphia, which is obtained by digestion in hot alcohol, excess of magnesia, and lastly, meconate of magnesia.

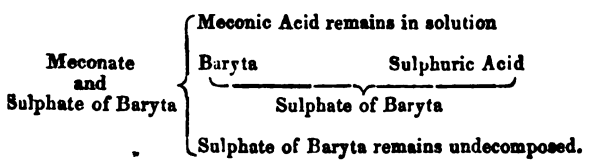


MECONIC ACID, ACCORDING TO ROBIQUET.

159. I. The meconate of magnesia is first dissolved in sulphuric acid, and afterwards decomposed by muriate of baryta; insoluble sulphate and meconate of baryta is formed; and lastly, by digestion in dilute sulphuric acid the meconic acid is liberated and sulphate of baryta is formed: the meconic acid is then obtained by evaporating the fluid to dryness.

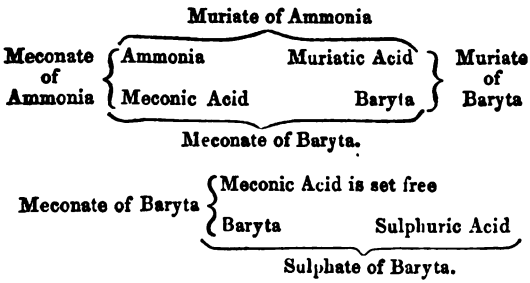
The changes which here occur are explained in the following diagrams.





MECONIC ACID, ACCORDING TO THOMSON.

160. II. Muriate of baryta is added to the fluid which remains after precipitating morphia by ammonia; meconate of baryta is precipitated, muriate of ammonia remains in solution: the meconate of baryta is then digested in sulphuric acid, sulphate of baryta is formed, and meconic acid is obtained by the evaporation of the supernatant fluid.



CHEMICAL CHARACTERS OF MORPHIA.

Morphia, when quite pure, is a white crystalline solid, which, according to Dr. Christison, always assumes the form of a flattened hexangular prism. It has a faintly bitter

taste, but no smell. It is very sparingly soluble in water: ether dissolves rather more; but its proper solvents are hot alcohol, and the diluted mineral and vegetable acids. Its solution in alcohol has a bitter taste; but the solution must be very strong, otherwise the acrid taste of the alcohol completely disguises it. From its solution in hot alcohol, the morphia is again deposited, on cooling, in a crystalline form. From its solution in acids morphia is precipitated on the addition of an alkali; but care must be taken not to add an excess of the alkali, which would redissolve the precipitate.

On the addition of per-muriate of iron to water in which finely-powdered morphia is suspended, the fluid speedily assumes a green, or greenish-blue colour, depending on the quantity of morphia present.

On the addition of strong nitric acid to pure morphia, it immediately acquires an orange-red colour; depending, however, on the purity of the morphia which is used. If the morphia is very pure and white, the colour produced is pale; but if the morphia which is ordinarily supplied to the apothecary for medical purposes be employed, then the colour produced is very deep. This, I think, is a strong argument in favour of an opinion which is maintained by many chemists, that the colour produced by the action of nitric acid on morphia is owing to some resinoid matter which adheres to the morphia, and not to the morphia itself.

It is also stated by some chemists, that morphia which has been coloured by nitric acid is deprived of its colour by some de-oxidizing substance, proto-muriate of tin for example. My own experiments tend to confirm this opinion; I took two equal portions of morphia, and added an equal quantity of nitric acid to each, both

portions were coloured to the same extent: one of them I diluted with water, to the other I added an equal quantity of a solution of proto-muriate of tin. Immediately after dilution, both fluids were of a bright yellow colour; but, in the space of about half an hour, that portion to which the proto muriate of tin had been added became evidently much paler, and, in the space of a few hours, quite colourless, while the portion which had only been diluted with water remained unchanged. This tends to prove, that morphia which has been coloured by nitric acid, may be again deprived of colour by de-oxidizing substances. But this, I am aware, is not the opinion of Dr. Christison. The coloration of morphia by nitric acid must not, however, be relied on as a test, because brucia and strychnia produce the same appearances when acted on by nitric acid; but as a test for the detection of nitric acid it is infallible.

On the application of heat, morphia fuses into a reddish-brown mass, which, on cooling, has a radiated crystalline appearance: on the application of a stronger heat it chars; white fumes having a peculiar odour are given off; and lastly, it kindles, burning with a brilliant white flame.

Morphia is not unfrequently sophisticated with narcotine; and I am not aware of any good test for the detection of this adulteration. Thus, both are soluble in the diluted acids, alcohol, and water. Pure ether dissolves narcotine much more readily than morphia; but the ether to which the apothecary has access always contains too large a portion of alcohol to allow of its use for this purpose, since alcohol dissolves morphia as readily as ether dissolves narcotine: both are acted on by nitric acid, the morphia producing a beautiful orange-red colour, and

the narcotine a brilliant yellow; but when the two are mixed, this test is evidently of no avail: when the narcotine or morphia so coloured is acted on by protomuriate of tin, the colour is destroyed in both instances.

Morphia and narcotine are both fusible, but the latter fuses more readily than the former; it follows, therefore, if a specimen of morphia be adulterated with narcotine, it will fuse more readily than pure morphia: this test might be used comparatively. For this purpose it is necessary to take a portion of the suspected morphia, to place it on the blade of a knife, beside a specimen of known purity, and to apply heat equally to both. If the suspected portion fuses first, it may be inferred that the specimen is impure; but, in my opinion, this test is not available, for this reason, that we cannot ensure the application of an equal temperature to each.

The salts which have morphia for their base are very soluble in water, but in all other respects have the same peculiar characters as the pure alkali.

MECONIC ACID.

Meconic acid, as commonly prepared, occurs in the form of brownish-yellow scales. It may, however, be obtained perfectly colourless, either by precipitating its solution by acetate of lead, and decomposing the meconate of lead by sulphuretted hydrogen, after repeating this operation two or three times, nearly colourless crystals

of meconic acid may be obtained by evaporation; or by sublimation. This latter process, however, is a very expensive one, for the point at which it sublimes is also the point at which it decomposes, occasioning a very considerable loss of the acid. Its solution in water reddens litmus paper; produces a beautiful cherry-red colour on the addition of a per-salt of iron; and a black precipitate on the addition of per-chloride of gold, with a few drops of potassa to neutralize the excess of acid. This test was first proposed by Mr. J. Cooper, jun. It produces a green precipitate with the sulphate of copper, which disappears on boiling, and again appears on cooling. When heated in a tube, it partly sublimes into the cooler part of the tube, in the form of filamentous radiated crystals; but the greater part suffers entire decomposition.

An examination of the peculiar chemical characters of opium, and its active principles, will at once indicate that, in analyzing the contents of the stomach for the detection of this poison, meconic acid ought to be the principal object of our search; but hitherto even the detection of this acid was liable to fallacy, and for this reason; until lately the principal distinguishing character of meconic acid was the production of a blood-red colour with a per-salt of iron; but the sulpho-cyanic acid, which is contained in the saliva, produces the same appearance with the per-salts of iron. This fact being known, would, however well satisfied one might be in his own mind of the presence of opium, tend materially to invalidate his evidence in a court of justice, unless he were prepared to meet this objection by some more characteristic test.

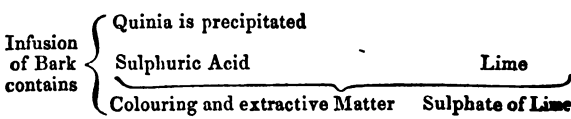
The per-chloride of gold, to which I have already

referred, is likely to supply this desideratum, for while a fluid containing meconic acid is changed to dark brown or black by the per-chloride of gold, a solution of sulpho-cyanic acid, or its salts, suffer no change of colour.

Some other active principles have lately been discovered in opium by MM. Pelletier and Courbe, but since no correct description has yet been published, it would be premature for me to give any description of them here.

QUINIA AND CINCHONIA.

161. QUINIA is obtained by adding caustic lime to an infusion of cinchona bark slightly acidulated with sulphuric acid; the lime combines with the sulphuric acid to form insoluble sulphate of lime, and the quinia which was held in solution by the sulphuric acid is precipitated.



The precipitate consisting of quinia, sulphate of lime, colouring and extractive matter, may be treated in two ways. 1st. It may be digested in diluted sulphuric acid, which dissolves the quinia and colouring matter and leaves the sulphate of lime untouched; the fluid is then to be boiled with pure animal charcoal, which removes the colouring matter, and pure sulphate of quinia may be obtained by evaporation. 2nd. Or the precipitate may be digested first in weak alcohol, which removes the

colouring matter; and in the next place it is to be boiled in strong alcohol, which dissolves the quinia and leaves the sulphate of lime untouched. The alcoholic solution, on cooling, deposits pure quinia.

CINCHONIA is prepared in precisely the same way as quinia.

PECULIAR CHARACTERS AND PROPERTIES OF CINCHONIA.

CINCHONIA is a white translucent crystalline body:—nearly insoluble in boiling or cold water, but very soluble in alcohol, ether, and acids, sparingly so in the fixed and volatile oils. It is nearly tasteless, but its solution in alcohol, or any acid, is powerfully bitter, imparting at the same time the peculiar flavour of the bark. It restores the colour of reddened litmus, and neutralizes acids forming salts, which neither act on litmus nor turmeric paper, and therefore is an alkali. The sulphate of cinchonia is very soluble and bitter; it forms crystals, the primary form of which is a doubly oblique rhombic prism; the muriate, nitrate, and acetate, are also very soluble in water; but the tartrate, oxalate, and gallate, are nearly insoluble in cold water; on this account it is that astringent infusions are incompatible with infusion of cinchona bark. When pure cinchonia is subjected to heat, it first slightly decrepitates; as the heat increases a part sublimes, and then it melts and chars.

PECULIAR CHARACTERS AND PROPERTIES OF QUINIA.

Quinia is a white flocculent precipitate, incapable of assuming a crystalline form under ordinary circumstances: —nearly insoluble water, sparingly so in fixed and volatile oils, and ether, but very soluble in alcohol, which

is in fact its proper solvent:—its solution in alcohol is intensely bitter:—it has decidedly alkaline characters, combining with acids and forming salts, the most important of which is the sulphate, which is a silken filamentous-looking substance very much like amianthus, soluble in water, and on that account employed medicinally; in other respects its properties coincide with those of the pure alkali. A solution of sulphate of quinia in water presents a peculiar milky appearance under certain circumstances, which has been called an *opalescence*. A solution of sulphate of cinchonia does not present this appearance:—the tartrate, gallate, and oxalate, are insoluble in cold water. Quinia and its sulphate on the application of heat readily fuse, and show no tendency to sublime; on the application of a higher temperature, they suffer entire decomposition, emitting at the same time a most intolerable odour.

Since very large quantities of sulphate of quinia are employed medicinally, and as it is an article of considerable commercial value, great inducement is held out for manufacturers, who are careless as to the manner in which they acquire gain, to sophisticate it. The substances employed are, water, sugar, gum, starch, ammoniacal salts, earthy salts, cafea, and probably sulphate of cinchonia.—To detect an excess of water, desiccation alone is necessary; 100 grains of pure sulphate of quinia should only lose 8 or 10 grains of water.—To detect the sugar, precipitate the quinia by means of an alkali. The bitter taste being now removed, the saccharine taste will generally be perceived; if not, evaporate the fluid to dryness, and boil what remains in a small quantity of alcohol; if any sugar be present, the alcohol will dissolve it, and on evaporation leave it in a solid form. If the

presence of starch be suspected, boil a portion of the substance in water; if the quantity be considerable, the fluid will become thick and ropy, which would render further examination unnecessary; if, however, the quantity be small, allow the fluid to cool, and then add a small portion of tincture of iodine; if any starch be present, a blue colour is immediately produced, otherwise the fluid remains unchanged. If gum be present, it may be detected by boiling the impure salt in strong alcohol; the gum being insoluble, remains, and may be recognised by its solubility in cold water, forming with it a thick mucilaginous fluid. If any ammoniacal salt has been employed, nothing more is necessary than to drop the suspected substance into a warm solution of potassa; ammoniacal gas will be given off, which will be rendered evident by holding the stopper of a muriatic acid bottle over the orifice of the vessel.—Earthy salts, such as the sulphates of lime and magnesia, remain after the destruction of sulphate of quinia by heat.—Cafea, the active principle of coffee, bears a very close resemblance to sulphate of quinia; and since it can be procured, at a trifling expense, even from damaged coffee, it may probably be used for the sophistication of that drug; to detect it, place a portion of the suspected drug in a test tube and cautiously apply heat, it melts, and if any cafea be present it will sublime and condense in the cooler part of the tube in the form of small acicular crystals, while the sulphate of quinia will suffer entire decomposition.*

* The above process for detecting the presence of cafea in sulphate of quinia was suggested by a kind but unknown friend, who had access to the proofs previous to publication; I have repeated the experiment, and I found it to succeed very well.

—Should the presence of sulphate of cinchonia be suspected, crystallization from hot alcohol will readily distinguish between the two: the sulphate of quinia being deposited in the form of silky filaments, while the sulphate of cinchonia assumes a bold crystalline form. It is also highly probable that salicin is frequently mixed with the sulphate of quinia, and its detection is a matter of some difficulty; but since it possesses medicinal powers analogous to quinia, its admixture with sulphate of quinia is of trifling importance.

All the other vegetable alkalies are prepared in the manner which I have already described; I shall not therefore describe them.

VINOUS FERMENTATION.

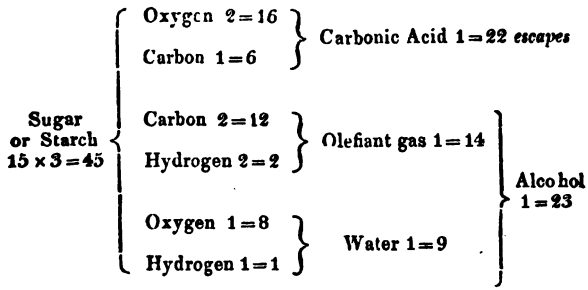
162. When sugar, starch, or any body containing either of these principles, is submitted to the vinous fermentation, the following changes occur:—Pure sugar, or starch,* according to an analysis made by Dr. Prout, consists of one atom of carbon, one atom of hydrogen, and one atom of oxygen; which may be represented by the following symbol:—

Ox.	1 atom =	8
Hy.	1 .... =	1
C.	1 .... =	6
Sugar	1 .... =	15

To explain the changes which occur during the vinous

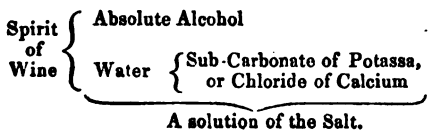
* This apparent anomaly of two bodies being similarly constituted, is readily explained by supposing that, although the proportion of their constituents be the same, yet their arrangement must be entirely different.

fermentation, 3 atoms $15 \times 3 = 45$ are necessary, 2 of oxygen = 16 combine with 1 of carbon = 6 to form 1 atom of carbonic acid which escapes, leaving 2 of carbon = 12 + 2 of hydrogen = 2, which form 1 of olefiant gas = 14 and 1 of oxygen = 8 + 1 of hydrogen = 1, which form 1 of water = 9, the two together forming 1 atom of *absolute* alcohol = 23.


Sugar or Starch 15 x 3 = 45
Oxygen 2 = 16
Carbon 1 = 6
Carbonic Acid 1 = 22 escapes
Carbon 2 = 12
Hydrogen 2 = 2
Olefiant gas 1 = 14
Oxygen 1 = 8
Hydrogen 1 = 1
Water 1 = 9
Alcohol 1 = 23

RECTIFICATION OF ALCOHOL.

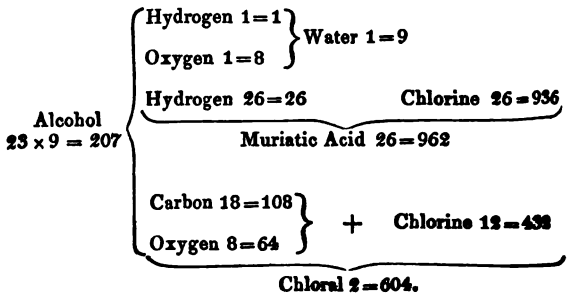
163. When dry sub-carbonate of potassa, or chloride of calcium, is added to ordinary spirit of wine, the alcohol is deprived of its water, and a solution of the salt results.



DECOMPOSITION WHICH OCCURS WHEN A CURRENT OF CHLORINE GAS IS PASSED THROUGH ALCOHOL.

164. When chlorine gas is passed through strong alcohol, muriatic acid gas and a new compound called chloral

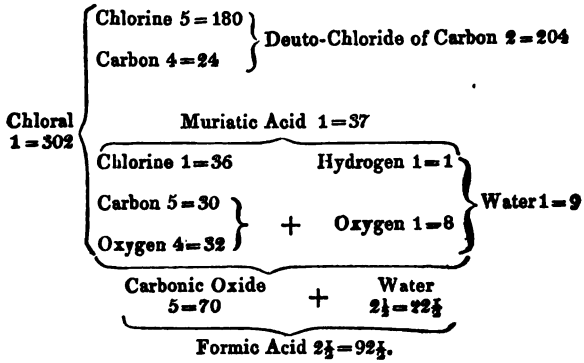
(from the initials of chlorine and alcohol) are formed in the following manner: 9 atoms of alcohol ($23 \times 9 = 207$) compounded of 27 atoms of hydrogen=27, 18 of carbon =108, and 9 of oxygen = 72, suffer decomposition; 26 atoms of chlorine=936 combine with 26 of hydrogen=26 to form 26 of muriatic acid=962, 12 atoms of chlorine= 432 combine with 18 of carbon=108 and 8 of oxygen= 64 to form 2 of chloral = 604, there remains 1 atom of hydrogen and 1 of oxygen, which combine to form 1 of water; the compounds which result therefore from the decomposition of 9 atoms of alcohol, are 26 atoms of muriatic acid, 2 atoms of chloral, and 1 atom of water.



DECOMPOSITION WHICH OCCURS WHEN CHLORAL IS ACTED ON BY AN ALKALI.

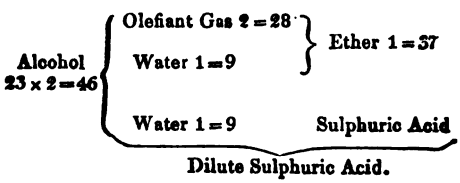
165. CHLORAL, by the action of an alkali, suffers entire decomposition, 1 atom of chloral is compounded of 9 of carbon, 6 of chlorine, and 4 of oxygen; 5 of chlorine combine with 4 of carbon to form a chloride of carbon, the remaining atom of chlorine decomposes 1 atom of water, and forms with its hydrogen 1 atom of muriatic acid, 5 of carbon then combine with 4 of oxygen

from the chloral, and 1 of oxygen from the water to form 5 atoms of carbonic oxide, which combine with $2\frac{1}{2}$ atoms of water to form $2\frac{1}{2}$ formic acid: the products are therefore deuto-chloride of carbon, muriatic acid, and formic acid.



FORMATION OF ETHER.

166. When the equal weights of alcohol and sulphuric acid are heated together, two atoms of alcohol compounded of 6 of hydrogen = 6, 4 of carbon = 24, and 2 of oxygen = 16, in all 46, or of 2 atoms of olefiant gas and 2 of water, suffer decomposition, the sulphuric acid seizes 1 atom of water, and leaves 1 atom of water = 9 + 2 of olefiant = 28 to form 1 atom of ether = 37.



A TABLE OF CHEMICAL EQUIVALENTS,

IN WHICH THE SIMPLE BODIES AND THEIR COMPOUNDS ARE ARRANGED ACCORDING TO THE PLAN PURSUED IN THE PREVIOUS PART OF THE TREATISE;

SHOWING,

I. THE ATOMIC EQUIVALENTS OF ALL THE SIMPLE BODIES.

II. THE PROPORTIONS IN WHICH THEY UNITE TO FORM DEFINITE *INORGANIC* COMPOUNDS.

III. THE PROPORTIONS IN WHICH THEY UNITE TO FORM VEGETABLE AND ANIMAL OR *ORGANIC* SUBSTANCES.

IV. SALTS.

PART I.

THE ATOMIC EQUIVALENTS OF ELEMENTARY BODIES.

THE SIMPLE ELECTRO-NEGATIVE BODIES; OR, THE SUPPORTERS OF COMBUSTION.

Oxygen .. Atomic Weight	8	Bromine .. Atomic Weight	78?
Chlorine	36	Fluorine	18
Iodine	124		

THE SIMPLE ELECTRO-POSITIVE BODIES; OR, THE SIMPLE NON-METALLIC COMBUSTIBLES.

Hydrogen .. Atomic Weight	1	Phosphorus .. Atomic Wt.	12
Azote or Nitrogen	14	Boron	8?
Carbon	6	Silicon	8
Sulphur	16	Selenium	40

THE METALS.

Potassium	Atomic Weight 40	Tungsten,	Atomic Weight 96
Sodium	24	Columbium	144?
Lithium	10	Antimony	44
Magnesium	12	Uranium	217
Calcium	20	Cerium	50
Barium	70	Cobalt	29
Stroutium	44	Titanium	24
Glucinum	18	Bismuth	72
Yttrium	34	Copper	64
Thorium	59	Tellurium	32
Aluminum	10	Lead	104
Zirconium	40?	Mercury	200
Manganese	28	Silver	110
Zinc	34	Gold	200?
Iron	28	Platinum	96
Tin	58	Rodium	44?
Cadmium	56	Palladium	56?
Arsenic	38	Iridium	30?
Molybdenum	48	Osmium	99?
Chromium	32	Nickel	30
Vanadium	68		

PART II.

THE PROPORTIONS IN WHICH SIMPLE BODIES UNITE TO FORM DEFINITE *INORGANIC* COMPOUNDS.

A. COMPOUNDS BETWEEN THE ELECTRO-NEGATIVE BODIES.

		Atomic Wt.
1 atom	Chlorine = 36 + 1 Oxygen = 8 form 1 Protoxide of Chlorine	44
1 —	Chlorine = 36 + 3 Oxygen = 24 form 1 Peroxide of Chlorine	60
1 —	Chlorine = 36 + 5 Oxygen = 40 form 1 Chloric Acid	76
1 —	Chlorine = 36 + 7 Oxygen = 56 form 1 Per-Chloric Acid	92
1 —	Iodine = 124 + 5 Oxygen = 40 form 1 Iodic Acid	164
1 —	Iodine = 124 + 1 Chlorine = 36 form 1 Chloride of Iodine	160

		Atomic Wt.
1 atom	Bromine = 78 + 5 Oxygen = 40 form 1 Bromic Acid	118
1 —	Bromine = 78 + 1 Chlorine = 36 form 1 Chloride of Bromine	114?
1 —	Bromine 78 + 1 Iodine = 124 form 1 Iodide of Bromine	202?

B. COMPOUNDS FORMED BY THE UNION OF THE SIMPLE NON-METALLIC COMBUSTIBLES WITH THE SUPPORTERS OF COMBUSTION.

1 atom	Hydrogen = 1 + 1 Oxygen = 8 form 1 Water	9
1 —	Hydrogen = 1 + 1 Chlorine = 36 form 1 Muriatic Acid	37
1 —	Hydrogen = 1 + 1 Iodine = 124 form 1 Hydriodic Acid	125
1 —	Hydrogen = 1 + 1 Bromine = 78 form 1 Hydro-Bromic Acid	79
1 —	Hydrogen = 1 + 1 Fluorine = 18 form 1 Hydro-Fluoric Acid	19
1 —	Nitrogen = 14 + 1 Oxygen = 8 form 1 Nitrous Oxide	22
1 —	Nitrogen = 14 + 2 Oxygen = 16 form 1 Nitric Oxide	30
1 —	Nitrogen = 14 + 3 Oxygen = 24 form 1 Hypo-Nitrous Acid	38
1 —	Nitrogen = 14 + 4 Oxygen = 32 form 1 Nitrous Acid	46
1 —	Nitrogen = 14 + 5 Oxygen = 40 form 1 Nitric Acid (*dry*)	54
1 —	Nitric Acid = 54 + 2 Water = 18 form 1 Liquid Nitric Acid	72
1 —	Nitrogen = 14 + 4 Chlorine = 144 form 1 Chloride of Nitrogen	158
1 —	Nitrogen = 14 + 3 Iodine = 372 form 1 Iodide of Nitrogen	386
1 —	Carbon = 6 + 1 Oxygen = 8 form 1 Carbonic Oxide	14
1 —	Carbon = 6 + 2 Oxygen = 16 form 1 Carbonic Acid	22
2 —	Carbon = 12 + 3 Chlorine = 108 form 1 *Per-Chloride of Carbon*	120
2 —	Carbon = 12 + 2⅓ Chlorine = 90 form 1 *Deuto-Chloride of Carbon*	102
1 —	Carbon = 6 + 1 Chlorine = 36 form 1 Proto-Chloride of Carbon	42

			Atomic Wt.
2 atoms	Carbon = 12 + 1 Chlorine = 36 form 1 Sub-Chloride of Carbon		48
1	—	Carbonic Oxide = 14 + 1 Chlorine = 36 form 1 Chloro-Carbonic Acid Gas	50
9	—	Carbon = 54 + 6 Chlorine = 216, and 4 Oxygen = 32 form 1 Chloral	302
1	—	Carbon = 6 + 2 Iodine = 248 form 1 Per-Iodide of Carbon	254?
1	—	Carbon = 6 + 1 Iodine = 124 form 1 Proto-Iodide of Carbon	130?
1	—	Carbon = 6 + — Bromine = — form 1 Bromide of Carbon	—
1	—	Sulphur = 16 + 3 Oxygen = 24 form 1 dry Sulphuric Acid	40
1	—	Sulphur = 16 + 2 Oxygen = 16 form 1 Sulphurous Acid	32
2	—	Sulphur = 32 + 5 Oxygen = 40 form 1 Hypo-Sulphuric Acid	72
2	—	Sulphur = 32 + 1 Oxygen = 8 form 1 Hypo-Sulphurous Acid	40
1	—	Sulphur = 16 + 1 Chlorine = 36 form 1 Chloride of Sulphur	52
1	—	Sulphur = 16 + 2 Chlorine = 72 form 1 Bi-Chloride of Sulphur	88
1	—	Sulphur = 16 + — Iodine = — form 1 of Iodide of Sulphur	—
1	—	Sulphur = 16 + — Bromine = — form 1 of Bromide of Iodine	—
2	—	Phosphorus = 24 + 1 Oxygen = 8 form 1 of Hypo-Phosphorous Acid	32
1	—	Phosphorus = 12 + 1 Oxygen = 8 form 1 Phosphorous Acid	20
1	—	Phosphorus = 12 + 2 Oxygen = 16 form 1 Phosphoric Acid	28
1	—	Phosphorus = 12 + 1 Chlorine = 36 form 1 Proto-Chloride of Phosphorus	48
1	—	Phosphorus = 12 + 2 Chlorine = 72 form 1 Per-Chloride of Phosphorus	84
1	—	Phosphorus = 12 + — Iodine = — form 1 Iodide of Phosphorus	—
1	—	Phosphorus = 12 + — Bromine = — form 1 Proto-Bromide of Phosphorus	—
1	—	Phosphorus = 12 + — Bromine = — form 1 Per-Bromide of Phosphorus	—

		Atomic Wt.
1 atom	Boron = 8 + 2 Oxygen = 16 form 1 Boracic Acid	24
1 —	Boron = 8 + 2 Chlorine = 72 form 1 Chloride of Boron	80
1 —	Boron = 8 + — Fluorine = — form 1 Fluo-Boric Acid Gas	—
1 —	Silicon = 8 + 1 Oxygen = 8 form 1 Silica	16
1 —	Silicon = 8 + — Chlorine = — form 1 Chloride of Silicon	—
1 —	Silicon = 8 + 1 Fluorine = 18 form 1 Fluo-Silicic Acid Gas	26
1 —	Selenium = 40 + 1 Oxygen = 8 form 1 Selenious Oxide	48
1 —	Selenium = 40 + 2 Oxygen = 16 form 1 Selenious Acid	56
1 —	Selenium = 40 + 3 Oxygen = 24 form 1 Selenic Acid	64

C. COMPOUNDS FORMED BY THE UNION OF THE SIMPLE NON-METALLIC COMBUSTIBLES WITH EACH OTHER.

3 atoms	Hydrogen = 3 + 1 Azote = 14 form 1 *Ammonia*	17
2 —	Hydrogen = 2 + 1 Carbon = 6 form 1 Bi-Hydruret of Carbon	8
2 —	Hydrogen = 2 + 2 Carbon = 12 form 1 Olefiant Gas	14
3 —	Hydrogen = 3 + 3 Carbon = 18 form 1 Super-Olefiant Gas	21
4 —	Hydrogen = 4 + 4 Carbon = 24 form 1 new Carburet of Hydrogen	28
3 —	Hydrogen = 3 + 6 Carbon = 36 form 1 Bi-Carburet of Hydrogen	39
1 —	Olefiant Gas = 14 + 1 Chlorine = 36 form 1 Chloric Ether	50
2 —	Olefiant Gas = 28 + 1 Iodine = 124 form 1 Hydriodide of Carbon	152
1 —	Hydrogen = 1 + 1 Sulphur = 16 form 1 Sulphuretted Hydrogen	17
1 —	Hydrogen = 1 + 2 Sulphur = 32 form 1 Bi-Sulphuretted Hydrogen	33
2 —	Hydrogen = 2 + — Phosphorus = — form 1 Sub-Phosphuretted Hydrogen	—
1 —	Hydrogen = 1 + 1 Phosphorus = 12 form 1 Per-Phosphuretted Hydrogen	13

			Atomic Wt.
1	atom	Hydrogen = 1 + 1 Selenium = 40 form 1 Seleuretted Hydrogen	41
1	—	Nitrogen = 14 + 2 Carbon = 12 form 1 Cyanogen	26
1	—	Cyanogen = 26 + 1 Oxygen = 8 form 1 Cyanous Acid	34
1	—	Cyanogen = 26 + 2 Oxygen = 16 form 1 Cyanic Acid	42
1	—	Cyanogen = 26 + 1 Chlorine = 36 form 1 Cyanide of Chloride	62
1	—	Cyanogen = 26 + 2 Chlorine = 72 form 1 Chloride of Cyanogen	98
1	—	Cyanogen = 26 + 1 Iodine = 124 form 1 Iodide of Cyanogen	150
1	—	Cyanogen = 26 + 1 Bromine = 78 form 1 Bromide of Cyanogen	104?
1	—	Cyanogen = 26 + 1 Hydrogen = 1 form 1 Hydro-Cyanic Acid	27
1	—	Hydro-Cyanic Acid = 27 + 2 Sulphur = 32 form 1 Sulpho-Cyanic Acid	59
1	—	Cyanogen = 26 + 1 Sulphur = 16 form 1 Sulphuret of Cyanogen	42?
1	—	Cyanogen = 26 + 2 Sulphur = 32 form 1 Bi-Sulphuret of Cyanogen	58
1	—	Cyanogen = 26 + — Selenium = — form 1 Selenio-Cyanic Acid	—
3	—	Cyanogen = 78 + 1 Iron = 28 form 1 Radicle of Ferro-Cyanic Acid	106
1	—	Radicle of Ferro-Cyanic Acid = 106 + 2 Hydrogen = 2 form 1 Ferro-Cyanic Acid	108
1	—	Carbon = 6 + 2 Sulphur = 32 form 1 Bi-Sulphuret of Carbon	38
1½	—	Sulphur = 24 + 1 Selenium = 40 form 1 Sulphuret of Selenium	64

D. METALLIC COMPOUNDS WITH OXYGEN.

1	atom	Potassium = 40 + 1 Oxygen = 8 form 1 Potassa	48
1	—	Potassium = 40 + 3 Oxygen = 24 form 1 Peroxide of Potassium	64
1	—	Sodium = 24 + 1 Oxygen = 8 form 1 Soda	32
1	—	Sodium = 24 + 1½ Oxygen = 12 form 1 Peroxide of Sodium	36
1	—	Lithium = 10 + 1 Oxygen = 8 form 1 Lithia	18

			Atomic Wt.
1	atom	Magnesium = 12 + 1 Oxygen = 8 form 1 Magnesia	20
1	—	Calcium = 20 + 1 Oxygen = 8 form 1 Lime	28
1	—	Barium = 70 + 1 Oxygen = 8 form 1 Baryta	78
1	—	Barium = 70 + 2 Oxygen = 16 form 1 Peroxide of Barium	86
1	—	Strontium = 44 + 1 Oxygen = 8 form 1 Strontia	52
1	—	Glucinum = 18 + 1 Oxygen = 8 form 1 Glucina	26
1	—	Thorium = 59 + 1 Oxygen = 8 form 1 Thorina	67
1	—	Yttrium = 34 + 1 Oxygen = 8 form 1 Yttria	42
1	—	Aluminum = 10 + 1 Oxygen = 8 form 1 Alumina	18
1	—	Zirconium = 40 + 1 Oxygen = 8 form 1 Zirconia	48
1	—	Manganese = 28 + 1 Oxygen = 9 form 1 Protoxide of Manganese	36
1	—	Manganese = 28 + 1½ Oxygen = 12 form 1 Deutoxide of Manganese	40
1	—	Manganese = 28 + 2 Oxygen = 16 form 1 Peroxide of Manganese	44
1	—	Protoxide of Manganese = 36 + 2 Deutoxide of Manganese = 80 form 1 Red-oxide of Manganese	116
1	—	Manganese = 28 + 3 Oxygen = 24 form 1 Manganic Acid	52
1	—	Manganese = 28 + 4 Oxygen = 32 form 1 Per-Manganic Acid	60
1	—	Zinc = 34 + 1 Oxygen = 8 form 1 Oxide Zinc	42
1	—	Iron = 28 + 1 Oxygen = 8 form 1 Protoxide of Iron	36
1	—	Iron = 28 + 1½ Oxygen = 12 form 1 Peroxide of Iron	40
2	—	Protoxide of Iron = 72 + 1 Peroxide of Iron = 40 form 1 Black Oxide of Iron	112
1	—	Tin = 56 + 1 Oxygen = 8 form 1 Protoxide of Tin	64
1	—	Tin = 56 + 2 Oxygen = 16 form 1 Peroxide of Tin	72
1	—	Cadmium = 56 + 1 Oxygen = 8 form 1 Oxide of Cadmium	64
1	—	Arsenic = 38 + 1 Oxygen = 8 form 1 Protoxide of Arsenic	46
1	—	Arsenic = 38 + 2 Oxygen = 16 form 1 Arsenious Acid	54
1	—	Arsenic = 38 + 3 Oxygen = 24 form 1 Arsenic Acid	62
1	—	Molybdenum = 48 + 3 Oxygen = 24 form 1 Molybdic Acid	72

			Atomic Wt.
1	atom	Molybdenum = 46 + 2 Oxygen = 16 form 1 Deutoxide of Molybdenum	64
1	—	Molybdenum = 48 + 1 Oxygen = 8 form 1 Protoxide of Molybdenum	56
1	—	Chromium = 32 + 1 Oxygen = 8 form 1 Protoxide of Chromium	40
1	—	Chromium = 32 + 2½ Oxygen = 20 form 1 Chromic Acid	52
1	—	Chromic Acid = 52 + 6 Protoxide of Chromium = 240 form 1 Brown Oxide of Chromium	292
1	—	Vanadium = 68 + 1 Oxygen = 8 form 1 Protoxide of Vanadium	76
1	—	Vanadium = 68 + 2 Oxygen = 16 form 1 Deutoxide of Vanadium	84
1	—	Vanadium = 68 + 3 Oxygen = 24 form 1 Vanadic Acid	92
1	—	Tungsten = 96 + 2 Oxygen = 16 form 1 Deutoxide of Tungsten	112
1	—	Tungsten = 96 + 3 Oxygen = 24 form 1 Tungstic Acid	120
1	—	Columbium = 144 + 1 Oxygen = 8 form 1 Columbic Acid	152
1	—	Antimony = 44 + 1 Oxygen = 8 form 1 Protoxide of Antimony	52
1	—	Antimony = 44 + 1½ Oxygen = 12 form 1 Deutoxide of Antimony	56
1	—	Antimony = 44 + 2 Oxygen = 16 form 1 Peroxide of Antimony	60
1	—	Uranium = 217 + 1 Oxygen = 8 form 1 Protoxide of Uranium	225
1	—	Uranium = 217 + 1½ Oxygen = 12 form 1 Peroxide of Uranium	229
1	—	Cerium = 50 + 1 Oxygen = 8 form 1 Protoxide of Cerum	58
1	—	Cerium = 50 + 1½ Oxygen = 12 form 1 Peroxide of Cerium	62
1	—	Cobalt = 29 + 1 Oxygen = 8 form 1 Protoxide of Cobalt	37
1	—	Cobalt = 29 + 1½ Oxygen = 12 form 1 Peroxide of Cobalt	41
1	—	Titanium = 24 + 1 Oxygen = 8 form 1 Protoxide of Titanium	32
1	—	Titanium = 24 + 2 Oxygen = 16 form 1 Titanic Acid	40

			Atomic Wt.
1	atom	Bismuth = 72 + 1 Oxygen = 8 form 1 Oxide of Bismuth	80
1	—	Copper = 64 + 1 Oxygen = 8 form 1 Protoxide of Copper	72
1	—	Copper = 64 + 2 Oxygen = 16 form 1 Peroxide of Copper	80
1	—	Tellurium = 32 + 1 Oxygen = 8 form 1 Oxide of Tellurium	40
1	—	Lead = 104 + 1 Oxygen = 8 form 1 Protoxide of Lead	112
1	—	Lead = 104 + 1½ Oxygen = 12 form 1 Deutoxide of Lead	116
1	—	Lead = 104 + 2 Oxygen = 16 form 1 Peroxide of Lead	120
1	—	Mercury = 200 + 1 Oxygen = 8 form 1 Protoxide of Mercury	208
1	—	Mercury = 200 + 2 Oxygen = 16 form 1 Peroxide of Mercury	216
1	—	Silver = 110 + 1 Oxygen = 8 form 1 Oxide of Silver	118
1	—	Gold = 200 + 24 Oxygen = 1 form 1 Peroxide of Gold	224
1	—	Gold = 200 + 2 Oxygen = 16 form 1 Deutoxide of Gold	216
1	—	Platinum = 96 + 1 Oxygen = 8 form 1 Protoxide of Platinum	104
1	—	Platinum = 96 + 1 Oxygen = 8 form 1 Deutoxide of Platinum	104
1	—	Platinum = 96 + 2 Oxygen = 16 form 1 Peroxide of Platinum	112
1	—	Rhodium = 44 + 1 Oxygen = 8 form 1 Protoxide of Rhodium	52
1	—	Rhodium = 44 + 2 Oxygen = 16 form 1 Peroxide of Rhodium	60
1	—	Palladium = 56 + 1 Oxygen = 8 form 1 Protoxide of Palladium	64
1	—	Palladium = 56 + 2 Oxygen = 16 form 1 Peroxide of Palladium	72
1	—	Iridium = 30 + 1 Oxygen = 8 form 1 Protoxide of Iridium	38
1	—	Iridium = 30 + 1½ Oxygen = 12 form 1 Sesqui-Oxide of Iridium	42
1	—	Iridium = 30 + 2 Oxygen = 16 form 1 Deutoxide of Iridium	46

		Atomic Wt.
1 atom	Iridium = 30 + 3 Oxygen = 24 form 1 Peroxide of Iridium	54
1 —	Osmium = 99 + 1 Oxygen = 8 form 1 Protoxide of Osmium	107
1 —	Osmium = 29 + 1½ Oxygen = 12 form 1 Sesqui-Oxide of Osmium	111
1 —	Osmium = 99+2 Oxygen = 16 form 1 Deutoxide of Osmium	115
1 —	Osmium = 99 + 3 Oxygen = 24 form 1 Teroxide of Osmium	123
1 —	Osmium = 99 + 4 Oxygen = 32 form 1 Peroxide of Osmium	131
1 —	Nickel = 30 + 1 Oxygen = 8 form 1 Protoxide of Nickel	38
1 —	Nickel = 30 + 1½ Oxygen = 12 form 1 Peroxide of Nickel	42

E. METALLIC COMPOUNDS WITH CHLORINE, IODINE, BROMINE, AND FLUORINE.

Potassium.	
Chloride (P. 1 = 40 + 1 Chl. = 36)	76
Iodide (Iod. 1=124+1 Pot.=40)	164
Bromide (Br. 1=78+1 Pot.=40)	118
Sodium.	
Chloride (Sod. 1=24+1 Chl.=36)	60
Iodide (Sod. 1=24+1 Iod.=124)	148
Bromide (Sod. 1=24+1 Br.=78)	102
Lithium.	
Chloride (Lith. 1=10+10 Chl.=36)	46
Iodide (Lith. 1=10+1 Iod. 124)	134
Magnesium.	
Chloride (Mag. 1=12+1 Chl.=36)	48
Iodide (Mag. 1=12+1 Iod.=124)	136
Bromide (Mag. 1=12+1 Br.=78)	90
Calcium.	
Chloride (Cal. 1=20+1 Chl.=36)	56
Iodide (Cal. 1=20+1 Iod.=124)	144
Bromide (Cal. 1=20+1 Br.=78)	98
Fluoride (Cal. 1=20+1 Fl.=18)	38
Barium.	
Chloride (Bar. 1=70+1=36)	106
Iodide (Bar. 1=70+1 Iod.=124)	194
Bromide (Bar. 1=70+1 Br.=78)	148

	Atomic Wt.
Strontium.	
Chloride (Str. 1 = 44 + 1 Chl. = 36)	80
Iodide (Str. 1 = 44 + 1 Iod. = 124)	168
Bromide (Str. 1 = 44 + 1 Br. = 78)	122
Glucinum.	
Chloride (Gl. 1 = 18 + 1 Chl. = 36)	54
Yttrium.	
Chloride (Ytt. 1 = 34 + 1 Chl. = 36)	70
Aluminum.	
Chloride (Al. 1 = 10 + 1 Chl. = 36)	46
Manganese.	
Chloride (Mang. 1 = 28 + 1 Chl. = 36)	64
Per-Chloride (Mang. 1 = 28 + 4 Chl. = 144)	172
Fluoride (Mang. 1 = 28 + 4 Fl. = 72)	100
Zinc.	
Chloride (Zinc 1 = 34 + 1 Chl. = 36)	70
Iodide (Zinc 1 = 34 + 1 Iod. = 124)	158
Bromide (Zinc 1 = 34 + 1 Bro. = 78)	112
Iron.	
Chloride (Ir. 1 = 28 + 1 Chl. = 36)	64
Per-Chloride (Ir. 1 = 28 + 1½ Chl. = 54)	82
Iodide (Ir. 1 = 28 + 1 Iod. = 124)	152
Per-Iodide (Ir. 1 = 28 + 1½ Iod. = 186)	214
Bromide (Ir. 1 = 28 + 1 Br. = 78)	106
Per-Bromide (Ir. 1 = 28 + 1½ Br. = 117)	145
Tin.	
Chloride (Tin 1 = 58 + 1 Chl. = 36)	94
Per-Chloride (Tin 1 = 58 + 2 Chl. = 72)	130
Cadmium.	
Chloride (Cad. 1 = 56 + 1 Chl. = 36)	92
Arsenic.	
Chloride (Ars. 1 = 38 + 1 Chl. = 36)	74?
Iodide (Ars. 1 = 38 + 1 Iod. = 124)	162?
Bromide (Ars. 1 = 38 + 1½ Brom. = 117)	155?
Molybdenum.	
Per-Chloride (Molybd. 1 = 48 + 3 Chl. = 108)	156
Deuto-Chloride (Molybd. 1 = 48 + 2 Chl. = 72)	120
Proto-Chloride (Molybd. 1 = 48 + 1 Chl. = 36)	84
Chromium.	
Proto-Chloride (Chrom. 1 = 32 + 1 Chl. = 36)	68
Per-Chloride (Chrom. 1 = 32 + 2½ Chl. = 90)	122
Per-Fluoride (Chrom. 1 = 32 + 2½ Fluor. = 45)	77
Vanadium.	
Deuto-Chloride (Van. 1 = 68 + 2 Chl. 72)	140
Per-Chloride (Van. 1 = 68 + 3 Chl. = 108)	176
Deuto-Iodide (Van. 1 = 68 + 2 Iod. = 248)	316
Deuto-Bromide (Van. 1 = 68 + 2 Brom. = 156)	224
Deuto-Fluoride (Van. 1 = 68 + 2 Fluor. = 36)	104

	Atomic Wt.
Tungsten.	
Proto-Chloride (1 T. = 26 + 2 Chl. = 72)	168
Per-Chloride (1 T. = 96 + 3 Chl. = 108)	204
Columbium.	
Chloride (1 Col. = 144 + — Chl. = —)	—
Fluoride (1 Col. = 144 + — Fl. = —)	—
Antimony.	
Di-Chloride (2 Ant. = 88 + 1 Chl. = 36)	124
Proto-Chloride (1 Ant. = 44 + 1 Chl. = 36)	80
Bi-Chloride (1 Ant. = 44 + 2 Chl. = 72)	116
Iodide (1 Ant. = 44 + 1 Iod. = 124)	168
Bromide (1 Ant. = 44 + 1 Br. = 78)	122
Cobalt.	
Chloride (1 Cob. = 30 + 1 Chl. = 36)	66
Iodide (1 Cob. = 30 + 1 Iod. = 124)	150
Titanium.	
Sub-Chloride (2 Tit. = 64 + 1 Chl. = 36)	100
Chloride (1 Tit. = 32 + 1 Chl. = 36)	68
Bi-Chloride (1 Tit. = 32 + 2 Chl. = 72)	104
Bismuth.	
Chloride (1 Bism. = 72 + 1 Chl. = 36)	108
Iodide (1 Bism. = 72 + 1 Iod. = 124)	196
Bromide (1 Bism. = 72 + 1 Brom. = 78)	150
Copper.	
Proto-Chloride (1 Cop. = 64 + 1 Chl. = 36)	100
Per-Chloride (1 Cop. = 64 + 2 Chl. = 72)	136
Iodide (1 Cop. = 64 + 1 Iod. = 124)	188
Tellurium.	
Chloride (1 Tell. = 32 + 1 Chl. = 36)	68
Lead.	
Chloride (1 L. = 104 + 1 Chlor. = 36)	140
Iodide (1 L. = 104 + 1 Iod. = 124)	228
Mercury.	
Proto-Chloride (1 Mer. = 200 + 1 Chl. = 36)	236
Per-Chloride (1 Mer. = 200 + 2 Chl. = 72)	272
Proto-Iodide (1 Mer. = 200 + 1 Iod. = 124)	324
Per-Iodide (1 Mer. = 200 + 2 Iod. = 248)	448
Silver.	
Chloride (1 Sil. = 110 + 1 Chl. = 36)	146
Iodide (1 Sil. = 110 + 1 Iod. = 124)	234
Gold.	
Proto-Chloride (1 Gold = 200 + 1 Chl. = 36)	206
Per-Chloride (1 Gold = 200 + 3 Chl. 108)	308
Iodide (1 Gold = 200 + 1 Iod. = 124)	324
Bromide (1 Gold = 200 + 3 Brom. = 224)	424?

	Atomic Wt.
Platinum.	
Proto-Chloride (1 Plat. = 96 + 1 Chl. = 36)	132
Per-Chloride (1 Plat. = 96 + 2 Chl. = 72)	168
Rodium.	
Proto-Chloride (1 Rod. = 44 + 1 Chl. = 36)	80
Deuto-Chloride (1 Rod. = 44 + 2 Chl. = 72)	116
Per-Chloride (1 Rod. = 44 + 3 Chl. = 108).....	152
Palladium.	
Proto-Chloride (1 Pall. = 56 + 1 Chl. = 36)	92
Per-Chloride (1 Pall. = 56 + 2 Chl. = 72)	128
Iridium.	
Proto-Chloride (Irid. 1 = 30 + 1 Chl. = 36).....	66
Sesqui-Chloride (Irid. 1 = 30 + 1½ Chl. = 54).....	84
Deuto-Chloride (Irid. 1 = 30 + 2 Chl. = 72)	102
Per-Chloride (Irid. 1 = 30 + 3 Chl. = 108)	138
Osmium.	
Proto-Chloride (Os. 1 = 99 + 1 Chl. = 36)	135
Sesqui Chloride (Os. 1 = 99 + 1½ Chl. = 54)	153
Deuto-Chloride (Os. 1 = 99 + 2 Chl. = 72)	171
Ter-Chloride (Os. 1 = 99 + 3 Chl. = 108).....	207
Per-Chloride (Os. 1 = 99 + 4 Chl. = 144).....	243
Nickel.	
Proto-Chloride (Nick. 1 = 30 + 1 Chl. = 36)	66
Per-Chloride (Nick. 1 = 30 + 1½ Chl. = 54)	84

F. METALLIC COMPOUNDS WITH THE SIMPLE NON-METALLIC COMBUSTIBLES; OR, THE ELECTRO-POSITIVE BODIES.

Potassium.	
Hydruret (gaseous) composition unknown	—
Hydruret (solid) ditto.	—
Sulphuret (Pot. 1 = 40 + 1 Sul. = 16)	56
Bi-Sulphuret (Pot. 1 = 40 + 2 Sul. = 32).....	72
Tri-Sulphuret (Pot. 1 = 40 + 3 Sul. = 48)	88
Quadri-Sulphuret (Pot. 1 = 40 + 4 Sul. = 64)	104
Quinqui Sulphuret (Pot. 1 = 40 + 5 Sul. = 80)	120
Di-Phosphuret (Pot. 2 = 80 + 1 Phos. = 121)	92
Phosphuret (Pot. 1 = 40 + 1 Phos. = 12)	52
Cyanide (Pot. 1 = 40 + 1 Cyan. = 26)	66
Sodium.	
Sulphuret (Sod. 1 = 24 + 1 Sul. = 16)	40
Phosphuret (Sod. 1 = 24 + 1 Phos. = 12).....	36
Cyanide (Sod. 1 = 24 + 1 Cyan. = 26)	50
Lithium.	
Sulphuret (Lith. 1 = 10 + 1 Sul. = 16).....	26

	Atomic Wt.
Calcium.	
Sulphuret (Cal. 1 = 20 + 1 Sul. = 16)	36
Phosphuret (Cal. 1 = 20 + 1 Phos. = 12)	32
Barium.	
Sulphuret (Bar. 1 = 70 + 1 Sul. = 16)	86
Phosphuret (Bar. 1 = 70 + 1 Phos. = 12).....	82
Strontium.	
Sulphuret (Stron. 1 = 44 + 1 Sul. = 16).....	60
Phosphuret (Stron. 1 = 44 + 1 Phos. = 12)	56
Aluminum.	
Sulphuret (Alum. 1 = 10 + 1 Sul. = 16).....	26
Phosphuret (Alum. 1 = 10 + 1 Phos. = 12)	22
Selenuret (Alum. 1 = 10 + 1 Selen. = 40)	50?
Manganese.	
Proto-Sulphuret (M. 1 = 28 + 1 Sul. = 16)	44
Bi-Sulphuret (M. 1 = 28 + 2 Sul. = 32)	60
Oxy-Sulphuret (Protox. of M. 1 = 36 + 1 Sulph. of M. = 44).....	80
Zinc.	
Hydruret, composition unknown.	
Sulphuret (Z. 1 = 34 + 1 Sul. = 16)	50
Phosphuret (Z. 1 = 34 + 1 Phos. = 12).....	46
Iron.	
Proto-Sulphuret (Ir. 1 = 28 + 1 Sul. = 16)	44
Bi-Sulphuret (Ir. 1 = 28 + 2 Sul. = 32)	60
Phosphuret (Ir. 1 = 28 + 1 Phos. = 12)	40
Carburet Graphite, composition unknown.	
Tin.	
Proto-Sulphuret (Tin 1 = 58 + 1 Sul. = 16).....	74
Sesqui-Sulphuret (Tin 1 = 58 + 1½ Sul. = 24)	82
Bi-Sulphuret (Tin 1 = 58 + 2 Sul. = 32)	90
Cadmium.	
Sulphuret (Cad. 1 = 56 + 1 = 16)	72
Phosphuret (Cad. 1 = 56 + 1 Phos. = 12).....	68
Arsenic.	
Hydruret (solid) (Ars. 1 = 38 + 1 Hydr. = 1).....	39
Sesqui-Hydruret (gaseous) (Ars. 2 = 76 + 3 Hyd. 3)	79
Proto-Sulphuret (Ars. 1 = 38 + 1 Sulph. = 16)	54
Bi-Sulphuret (Ars. 1 = 38 + 2 Sulph. = 32).....	70
Per-Sulphuret (Ars. 1 = 38 + 3 Sulph. = 48)	86
Molybdenum.	
Bi-Sulphuret (Molyb. 1 = 48 + 2 Sulph. = 32).....	80
Per-Sulphuret (Molyb. 1 = 48 + 3 Sulph. = 48)	96
Chromium.	
Sulphuret (Chr. 1 = 32 + 1 Sulph. = 16)	48
Phosphuret (Chr. 1 = 32 + 1 Phos. = 12).....	44

	Atomic wt.
Vanadium.	
Bi-Sulphuret (Van. 1=68+2 Sulph.=32)	100
Per-Sulphuret (Van. 1=68+3 Sulph.=48)	116
Phosphuret (Van. 1=68+1 Phos.=12)	80
Bi-Cyanide (Van. 1=68+2 Cyan.=52)	120
Tungsten.	
Sulphuret (Tung. 1=96+2 Sulph.=32).....	128
Columbium.	
Sulphuret (Columb. 1=144+1 Sulph.=16)	160
Antimony.	
Sulphuret (Ant. 1=44+1 Sulph.=16)	60
Sesqui-Sulphuret (Ant. 1=44+1½ Sulph.=24) ..	68
Per-Sulphuret (Ant. 1=44+2 Sulph.=32)	76
Uranium.	
Sulphuret (Uran. 1=208+1 Sulph.=16)	124
Cerium.	
Sulphuret (Ce. 1=50+1 Sulph.=16).....	66
Cobalt.	
Proto-Sulphuret (Cob. 1=30+1 Sulph.=16)	46?
Sesqui-Sulphuret (Cob. 1=30+1½ Sulph.=24) ..	54?
Bi-Sulphuret (Cob. 1=30+2 Sulph.=32)	62?
Titanium.	
Sulphuret (Tit. 1=32+2 Sulph.=32)	64
Bismuth.	
Sulphuret (Bis. 1=72+1 Sulph.=16)	88
Copper.	
Proto-Sulphuret (Cop. 1=64+1 Sulph.=16)	80
Per-Sulphuret (Cop. 1=64+2 Sulph.=32)	96
Proto-Phosphuret (Cop. 1=64+1 Phos.=12)	76
Per-Phosphuret (Cop. 1=64+2 Phos.=24).....	88
Tellurium.	
Telluretted Hydrogen (Tel. 1=32+1 Hydr.=1)..	33
Lead.	
Sulphuret (Lead 1=104+1 Sulph.=16)	120
Phosphuret (Lead 1=104+1 Phos.=12)	116
Carburet (Lead 1=104+ Carb.=)	
Seleniuret (Lead 1=104+1 Sel.=40).....	144
Mercury.	
Proto-Sulphuret (Mer. 1=200+1 Sulph.=16)....	216
Per-Sulphuret (Mer. 1=200+2 Sulph.=32)	232
Bi-Cyanide (Mer. 1=200+2 Cyan.=52)	252
Silver.	
Sulphuret (Silver 1=110+1 Sulph.=16)	126
Phosphuret (Silver 1=110+1 Phos.=12).....	122
Cyanide (Silver 1=110+1 Cyan.=26)	136

	Atomic Wt.
Gold.	
Sulphuret (Gold 1 = 200 + 3 Sulph. = 48)	248
Platinum.	
Sulphuret (Plat. 1 = 96 + 1 Sulph. = 16)	112
Bi-Sulphuret (Plat. 1 = 96 + 2 Sulph. = 32)	128
Phosphuret (Plat. 1 = 96 + — Phos. = —)	—
Osmium.	
Proto-Sulphuret (Os. 1 = 99 + 1 Sulph. 16).....	115
Sesqui-Sulphuret (Os. 1 = 99 + 1½ Sulph. = 24)	123
Deuto-Sulphuret (Os. 1 = 99 + 2 Sulph. = 32).....	131
Ter-Sulphuret (Os. 1 = 99 + 3 Sulph. = 48).....	147
Quadri-Sulphuret (Os. 1 = 99 + 4 Sulph. = 64)	163
Nickel.	
Proto-Sulphuret (Nick. 1 = 30 + 1 Sulph. = 16)	46
Di-Sulphuret (Nick. 1 = 30 + 1½ Sulph. = 24).....	54
Phosphuret (Nick. 1 = 30 + — Phos. = —)	—
Carburet (Nick. 1 = 30 + — Carb. = —)	—

PART III.

TABLE OF THE COMPOSITION OF VEGETABLE AND ANIMAL SUBSTANCES.

I. VEGETABLE SUBSTANCES.

GUM,

According to Dr. Thomson, is composed of

6 atoms of Carbon	.. .. ..	36
6 — Oxygen	.. .. ..	48
6 — Hydrogen	.. ..	6
1 atom of Gum is	.. .. ..	90

SUGAR,

According to Dr. Prout, is composed of

1 atom of Carbon	.. .. ..	6
1 — Oxygen	.. .. ..	8
1 — Hydrogen	.. .. ..	1
1 atom of Sugar is	.. .. ..	15

OXALIC ACID,

According to Dr. Thomson, the anhydrous acid consists of

2 atoms of Carbon	.. .. ..	12
3 — Oxygen	.. .. ..	24
1 atom of Oxalic Acid is	..	36

Or it may be constituted of

1 atom of Carbonic Acid	.. ..	22
1 — Carbonic Oxide	.. ..	14
1 atom of Oxalic Acid is	.. ..	36

CRYSTALLIZED BENZIC ACID.

1 atom of Dry Benzic Acid	.	74
3 — Water	.. .. ..	27
1 atom of Crystal. Benzic Acid is		101

CROCONIC ACID.

According to M. Gmelin.

5 atoms of Carbon	.. .. ..	30
4 — Oxygen	.. .. ..	32
1 atom of Croconic Acid is	..	62

ACETIC ACID,

According to Dr. Prout.

4 atoms of Carbon	.. .. ..	24
3 — Hydrogen	.. ..	3
3 — Oxygen	.. .. ..	24
1 atom of Acetic Acid	.. ..	51

CITRIC ACID,

According to Dr. Thomson.

4 atoms of Carbon	.. .. ..	24
4 — Oxygen	.. .. ..	32
2 — Hydrogen	.. ..	2
1 atom of Citric Acid is	.. ..	58

PYRO-CITRIC ACID.

8 atoms of Carbon	.. .. ..	48
9 — Hydrogen	.. .. ..	9
5 — Oxygen	.. .. ..	40
1 atom of Pyro-Citric Acid is	..	97

GALLIC ACID,

According to Berzelius.

6 atoms of	Carbon	.. .. ..	36
3 —	Oxygen	.. .. ..	24
3 —	Hydrogen	.. .. ..	3
1 atom of Gallic Acid is		.. ..	63

CAMPHORIC ACID,

According to Liebig.

Carbon	56.29
Oxygen	36.82
Hydrogen	6.89
	100.

SACCHO LACTIC ACID,

According to Dr. Prout.

Carbon	33.0
Oxygen	61.5
Hydrogen	4.9
	99.4
Deficiency	6
	100.

MALIC ACID,

According to Dr. Prout.

4 atoms of	Carbon	.. .. ..	24
4 —	Oxygen	.. .. ..	32
3 —	Hydrogen	.. .. ..	3
1 atom of Malic Acid is		.. ..	59

According to an analysis lately made by M. Liebi malic acid is only allowed 1 atom of hydrogen, whi would make its atomic weight 57.

TARTARIC ACID. (DRY.)

4	atoms of	Carbon	24
5	—	Oxygen	40
2	—	Hydrogen	2
1	atom of	Tartaric Acid is ..	66

TARTARIC ACID. (CRYSTALLIZED.)

1	atom of	Dry Acid	66
1	—	Water	9
1	atom of	Cryst. Tartaric Acid is	75

MELLITIC ACID,

According to Liebig and Wohler.

4	atoms of	Carbon	24
3	—	Oxygen	24
1	atom of	Mellitic Acid is ..	48

BENZOIC ACID,

According to Berzelius.

15	atoms of	Carbon	90
6	—	Hydrogen	6
3	—	Oxygen	24
1	atom of	Benzoic Acid is ..	120

KINIC ACID,

According to Liebig.

15½	atoms of	Carbon	93
12	—	Hydrogen	12
12	—	Oxygen	96
1	atom of	Kinic Acid is ..	201

CAINCIC ACID,

According to Liebig.

Carbon	57.38
Oxygen	35.14
Hydrogen	7.48
	100.

FIXED OR FAT OILS.

OLIVE OIL,

According to Gay Lussac and Thenard.

10	atoms of	Carbon	60
11	—	Hydrogen	11
1	—	Oxygen	8
1 atom of Olive Oil is			79

VOLATILE AND ESSENTIAL OILS.

OIL OF TURPENTINE,

According to Dr. Ure.

14	atoms of	Carbon	84
10	—	Hydrogen	10
1	—	Oxygen	8
1 atom of Oil of Turpentine is			102

CAMPHOR,

According to Dr. Ure.

10	atoms of	Carbon	60
9	—	Hydrogen	9
1	—	Oxygen	8
1 atom of Camphor is			77

RESINS.

COMMON RESIN,

According to Gay Lussac and Thenard.

15	atoms of	Carbon	90
13	—	Hydrogen	13
2	—	Oxygen	16
1 atom of common Resin is ..			119

COMMON RESIN,

According to Dr. Thomson.

10	atoms of	Carbon	60
11	—	Hydrogen	11
3	—	Oxygen	24
1	atom of common Resin is ..		95

COMMON RESIN,

According to Dr. Ure.

8	atoms of	Hydrogen	8
8	—	Carbon	48
1	—	Oxygen	8
1	atom of common Resin is ..		64

SUCCINIC ACID,

According to Berzelius.

4	atoms of	Carbon	24
3	—	Oxygen	24
2	—	Hydrogen	2
1	atom of Succinic Acid is ..		50

STARCH,

According to Dr. Prout.

1	atom of	Carbon	6
1	—	Hydrogen	1
1	—	Oxygen	8
1	atom of Starch is		15

CAOUTCHOUC,

According to Dr. Ure.

3	atoms of	Carbon	18
2	—	Hydrogen	2
1	atom of Caoutchouc is		20

LIGNIN,

According to Gay Lussac and Thenard.

7	atoms of	Carbon	42
4	—	Oxygen	32
4	—	Hydrogen	4
1	atom of	Lignin is	78

INDIGO,

According to Mr. Crum.

16	atoms of	Carbon	96
4	—	Hydrogen	4
2	—	Oxygen	16
1	—	Azote	14
1	atom of	Indigo is	130

CARBAZOTIC ACID,

According to Dr. Buff.

10	atoms of	Carbon	60
10	—	Oxygen	80
4	—	Azote	64
1	atom of	Carbazotic Acid is ..	204

INDIGOTIC ACID,

According to Dr. Buff.

15	atoms of	Carbon	90
10	—	Oxygen	80
2	—	Azote	28
			198

TANNIN,

According to Berzelius.

6	atoms of	Carbon	36
4	—	Oxygen	32
3	—	Hydrogen	3
1	atom of	Tannin is	71

WAX,

According to Gay Lussac, Thenard, and Dr. Ure.

13	atoms of	Carbon	78
11	—	Hydrogen	11
1	—	Oxygen	8
1	atom of	Wax is	97

VEGETABLE ALKALIES.

MORPHIA,

According to Liebig, Pelletier, and Dumas.

35	atoms of	Carbon	210
18	—	Hydrogen	18
6	—	Oxygen	48
1	—	Azote	14
1	atom of	Morphia is	290

CINCHONIA,

According to Liebig, Pelletier, and Dumas.

21	atoms of	Carbon	126
11	—	Hydrogen	11
1	—	Azote	14
1	—	Oxygen	8
1	atom of	Cinchonia is	159

QUINIA,

According to Liebig, Pelletier, and Dumas.

21½	atoms of	Carbon	129
12	—	Hydrogen	12
2	—	Oxygen	16
1	—	Azote	14
1	atom of	Quinia is	171

STRYCHNIA,

According to Liebig, Pelletier, and Dumas.

30½	atoms of	Carbon	183
16	—	Hydrogen	16
3	—	Oxygen	24
1	—	Azote	14
1 atom of Strychnia is			237

BRUCIA,

According to Liebig, Pelletier, and Dumas.

33	atoms of	Carbon	198
18	—	Hydrogen	18
6	—	Oxygen	48
1	—	Azote	14
1 atom of Brucia is			278

PROXIMATE VEGETABLE PRINCIPLES NOT ALKALINE.

CAFFEIN,

According to Pfaff and Liebig.

8	atoms of	Carbon	48
5	—	Hydrogen	5
2	—	Oxygen	16
2	—	Azote	28
1 atom of Caffein is			97

SALICIN,

According to Pelouze and Gay Lussac.

2	atoms of	Carbon	12
2	—	Hydrogen	2
1	—	Oxygen	8
1 atom of Salicin is			22

NAPHTHA,

According to Dr. Thomson.

6	atoms of	Carbon	36
5	—	Hydrogen	5
1 atom of Naphtha is			41

NAPHTHALINE,

According to Dr. Ure.

2 atoms of Carbon	..	..	12
1 — Hydrogen	..	..	1
1 atom of Naphthaline is	..	..	13

SULPHO-NAPHTHALIC ACID,

According to Mr. Faraday.

20 atoms of Carbon	..	..	120
8 — Hydrogen	..	..	8
2 — Sulphuric Acid	..		80
1 atom Sulpho-Naphthalic Acid is			208

ALCOHOL,

According to Saussure.

2 atoms of Carbon	..	..	12
3 — Hydrogen	..	..	3
1 — Oxygen	..	..	8
1 atom of Alcohol is	..	..	23

ETHER.

4 atoms of Carbon	..	..	24
5 — Hydrogen	..	..	5
1 — Oxygen	..	..	8
1 atom of Ether is	..	..	37

NITROUS ETHER,

According to MM. Dumas and Boullay.

4 atoms of Carbon	..	..	24
5 — Hydrogen	..	..	5
4 — Oxygen	..	..	32
1 — Azote	..	..	14
1 atom of Nitrous Ether is		..	75

OR,

2 atoms of	Olefiant Gas	.. ..	28
1 —	Water	.. .. ..	9
1 —	Hypo-Nitrous Acid	..	38
1 atom of	Nitrous Ether is	..	75

ACETIC ETHER,

According to MM. Dumas and Boullay.

2 atoms of	Olefiant Gas	.. ..	28
1 —	Water	.. .. ..	9
1 —	Acetic Acid	.. ..	51
1 atom of	Acetic Ether is	..	88

SULPHO-VINIC ACID,

According to Mr. Hennel.

4 atoms of	Carbon	.. .. ..	24
4 —	Hydrogen	.. ..	4
2 —	Sulphuric Acid	..	80
1 atom of	Sulpho-Vinic Acid is		108

OIL OF WINE.

8 atoms of	Carbon	.. .. ..	48
8 —	Hydrogen	.. ..	8
2 —	Sulphuric Acid	..	80
1 atom of	Oil of Wine is	..	136

PYRO-ACETIC SPIRIT,

According to Liebig.

3 atoms of	Carbon	.. .. ..	18
3 —	Hydrogen	.. .. ..	3
1 —	Oxygen	.. .. ..	8
1 atom of	Pyro-Acetic Spirit is		29

PYROXYLIC SPIRIT,

According to MM. Macaire and Marcet.

6 atoms of Carbon	..	..	36
7 — Hydrogen	..	..	7
4 — Oxygen	..	..	32
1 atom of Pyroxylic Spirit is	..		75

THIRD DIVISION.

II. ANIMAL CHEMISTRY.

The ultimate constituents of animal matter are, oxygen, hydrogen, carbon, and azote; besides which, sulphur, iron, phosphorus, manganese, earthy and saline matters in small quantities, enter into the composition of animal bodies.

The proximate constituents which enter into the composition of organic bodies, are, gelatine, albumen, mucus, fibrin, urea, resin, sugar, oils, and acids.

A.—PROXIMATE ANIMAL PRINCIPLES.

COMPOSITION OF GELATINE,

According to Gay Lussac and Thenard.

15 atoms of Carbon	..	..	90
14 — Hydrogen	..	..	14
6 — Oxygen	..	..	48
2 — Azote	..	..	28
1 atom of Gelatine is	..	..	180

COMPOSITION OF ALBUMEN,

According to Gay Lussac and Thenard.

17	atoms of	Carbon	102
13	—	Hydrogen	13
6	—	Oxygen	48
2	—	Azote	28
1	atom of	Albumen is	191

COMPOSITION OF ALBUMEN,

According to Dr. Prout.

15	atoms of	Carbon	90
14	—	Hydrogen	14
6	—	Oxygen	48
2	—	Azote	28
1	atom of	Albumen is	180

If Dr. Prout's analysis of albumen be correct, it show that albumen and gelatine agree in composition, an therefore that their dissimilarity must depend on som difference in the arrangement of their constituents.

COMPOSITION OF FIBRIN,

According to Gay Lussac and Thenard.

18	atoms of	Carbon	108
14	—	Hydrogen	14
5	—	Oxygen	40
3	—	Azote	42
1	atom of	Fibrin is	204

COMPOSITION OF UREA,

According to Dr. Prout.

1	atom of	Carbon	6
1	—	Oxygen	8
1	—	Azote	14
2	—	Hydrogen	2
1	atom of	Urea is	30

SUGAR OF MILK,

According to Dr. Prout.

Carbon	40 parts
Water	60
	100

ANIMAL OILS.

COMPOSITION OF WHALE OIL,

According to Dr. Thomson.

12 atoms of	Carbon		72
17	— Hydrogen		17
2	— Oxygen		16
1 atom of Whale Oil is			105

COMPOSITION OF SPERMACETI OIL,

According to Dr. Ure.

10 atoms of	Carbon		60
9	— Hydrogen		9
1	— Oxygen		8
1 atom of Spermaceti Oil is ..			77

MARGARIC ACID.

Carbon	79 parts
Oxygen	9
Hydrogen	12
	100

OLEIC ACID.

Carbon	80.97 parts
Oxygen	7.7
Hydrogen ..	11.36
	100.

GLYCERINE,

According to Chevreul.

Carbon	40.071	parts
Oxygen	51.004	
Hydrogen	8.925	
	100.	

CHOLESTERINE,

According to Chevreul.

Carbon	85.095	parts
Oxygen	3.025	
Hydrogen	11.88	
	100.	

ANIMAL ACIDS.

COMPOSITION OF LITHIC OR URIC ACID,

According to Dr. Prout.

1 atom of	Hydrogen		1
1 —	Oxygen		8
2 —	Carbon		12
1 —	Azote		14
1 atom of Lithic Acid is			35

COMPOSITION OF PYRO-URIC ACID.

12 atoms of	Carbon		72
14 —	Oxygen		112
25 —	Hydrogen		25
3 —	Azote		42
1 atom of Pyro-Uric Acid is ..			251

COMPOSITION OF PURPURIC ACID,

According to Dr. Prout.

2 atoms of	Carbon		12
2 —	Oxygen		16
2 —	Hydrogen		2
1 —	Azote		14
1 atom of Purpuric Acid is ..			44

COMPOSITION OF SACCHO-LACTIC ACID,

According to Berzelius.

6	atoms of	Carbon	36
8	—	Oxygen	64
5	—	Hydrogen	5
1	atom of Saccho-Lactic Acid is		105

COMPOSITION OF FORMIC ACID,

According to Berzelius.

2	atoms of	Carbon	12
3	—	Oxygen	24
1	—	Hydrogen	1
1	atom of Formic Acid is	..	37

ALLANTOIC ACID,

According to Liebig.

3	atoms of	Carbon	18
4	—	Hydrogen	4
2	—	Oxygen	16
1	atom of Allantoic Acid is	..	38

B.—COMPLEX ANIMAL FLUIDS.

THE BLOOD.

THE SERUM OF HUMAN BLOOD,

According to Berzelius, is compounded of,

1. Water.
2. Acids—Muriatic, Lactic, Phosphoric.
3. Alkalies—Potassa, Soda.

And 4. Animal Matters—Albumen, Animal Matter soluble in Alcohol, Animal Matter soluble in Water.

In the following proportions:—

Water		905.0
Albumen		80.0
Muriates of Potassa and Soda	6	10.0
Lactate of Soda and Animal Matter	4	
Soda, Phosphate of Soda, and a little Animal Matter		4.1
Loss		0.9
		1000.0

The crassamentum, or clot, separates into two parts: coagulable lymph, or fibrin, and red globules; the analysis of the first has been already given.

COMPOSITION OF THE ASHES OF THE RED GLOBULES,

According to Berzelius.

Oxide of Iron		50.0
Sub-Phosphate of Iron		7.5
Phosphate of Lime, with a small quantity of Magnesia		6.0
Pure Lime		20.0
Carbonic Acid and Loss		16.5
		100.0

THE fluids necessary for digestion are, saliva, gastric and pancreatic juices, and bile.

COMPOSITION OF SALIVA,

According to Tiedemann and Gmelin.

Water, Muriate, Sulphate, Phosphate, Acetate, Carbonate, and Sulpho-Cyanate of Potassa, Phosphate and Carbonate of Lime, and Magnesia.

It also contains three proximate principles; viz. proper salivary matter, mucus, and osmazome; and occasionally a little albumen, and a minute portion of phosphorus dissolved in fatty matter.

PANCREATIC JUICE.

Formerly the saliva and pancreatic juice were held to be similar, the experiments of Tiedemann and Gmelin have however pointed out the following differences:—1st. The pancreatic juice yields more solid matter than saliva. 2dly. The pancreatic juice contains abundance of albumen and very little mucus, or salivary matter, contrary to saliva. 3dly. It differs from saliva in being neutral, or at most contains a little carbonate of potassa. 4thly and lastly. The saliva contains sulpho-cyanic acid, which the pancreatic juice does not.

HUMAN BILE.

Human bile, according to Thenard, is composed of water, yellow insoluble matter, yellow soluble matter, albumen, resin, soda, and several neutral salts. In addition picromel and cholesterine have been discovered.

CHYLE (IN THE DOG),

According to Dr. Prout.

	Vegetable Food.	Animal Food.
Water	93.6	89.2
Fibrin	0.6	0.8
Incipient Albumen?	4.6	4.7
Albumen, with a little red colouring matter	0.4	4.6
Sugar of Milk	a trace	—
Oily Matters	a trace	a trace
Saline Matters	0.8	0.7
	100.	100.

SKIMMED MILK (FROM THE COW),

According to Berzelius.

Water	928.75
Cheese, with a trace of Butter	28.
Sugar of Milk	35.
Muriate of Potassa	1.70
Phosphate of Potassa	0.25
Lactic Acid, Lactate of Potassa, and a trace of Lactate of Iron	6.
Earthy Phosphates	0.30
	1000.

CASEOUS MATTER (CHEESE),

According to Gay Lussac and Thenard.

Carbon	59.781
Hydrogen	7.429
Oxygen	11.409
Nitrogen	21.381
	100.

MUCUS OF THE NOSE,

According to Berzelius.

Water	933.7
Mucous Matter	53.3
Muriates of Potassa and Soda	5.6
Impure Lactate of Soda	0.9
Albumen and Animal Matter insoluble in Water but soluble in Alcohol	3.5
Loss	3.
	1000.0

TEARS.

The tears consist of water, an animal fluid like albumen, another like mucus, and several neutral salts.

HUMOURS OF THE EYE,

According to Berzelius.

	Aqueous humour.	Vitreous humour.
Water	98.10	98.40
Albumen	a trace	0.16
Muriates and Lactates	1.15	1.42
Soda, with Animal Matter soluble in Water ..	.75	0.02
	100.	100.

CRYSTALLINE LENS,

According to Berzelius.

Water	58.
Peculiar Matter	35.9
Muriates, Lactates, and Animal Matter soluble in Alcohol	2.4
Animal Matter soluble only in Water ..	1.3
Insoluble Membrane	2.4
	100.

LIQUOR PERICARDII,

According to Dr. Bostock.

Water	92.
Albumen	5.5
Mucus	2.
Muriate of Soda	0.5
	100.

LIQUOR AMNII (OF THE COW),

According to Dr. Prout.

Water	977.
Albumen	2.6
Substance soluble in Alcohol	16.6
Saline substances and Sugar of Milk	3.8
	100.

The liquor amnii in the human subject contains water, albumen, gelatine, with a portion of muriate and carbonate of soda, and phosphate of lime.

SYNOVIA,

According to Margueron.

Tebrous Matter	11.86
Albumen	4.52
Muriate of Soda	1.75
Soda	0.71
Phosphate of Lime	0.70
Water	80.46
	100.

PERSPIRATION,

According to Dr. Bostock.

Water	981.70
Animal Matter	4.60
Muriate of Soda	12.56
Soda	1.14
	1000.

URINE.

Urine is the most important, and at the same time the most complex, animal fluid in the body, for which reason I deem it necessary to give a short description of its chemical characters, and also of those concretions which occasionally form in the bladder, hence called *Urinary Calculi.*

Urine in the healthy state is a transparent and nearly colourless fluid; its specific gravity varies, ranging between 1010 and 1030; when newly voided it should feebly redden litmus paper, the cause of this is variously stated. Berzelius attributes it to the presence of free acid; Dr. Prout adduces the presence of a super-salt to account

for this effect on litmus paper. The latter I think is more probable. The substances which commonly enter into the composition of healthy urine are as follows:—

1. Water.
2. Acids—Sulphuric, Muriatic, Phosphoric, Uric or Lithic, Lactic.
3. Alkalies—Ammonia, Potassa, Soda, Lime, Magnesia.
4. Animal Matters—Urea, Albumen, Mucus, peculiar colouring Matter, Gelatine.

Besides those already mentioned, it is probable that urine contains a small portion of sulphur, silica, hydro-fluoric acid; and it is stated that the urine of infants sometimes contains benzoic acid; the presence of sulphur is known by the tarnish which is produced on silver vessels, in which urine containing sulphur is boiled; silica remains as an insoluble powder, after the action of alcohol, water, and diluted acid on the extract of urine; hydro-fluoric acid has never been found in urine by any other chemist besides Berzelius, hence its existence is doubtful. Urine in a state of disease contains, besides those substances already mentioned, occasionally the following matters:—

Acids—Nitric, Purpuric, Oxalic, Carbonic.
Animal Matters—Sugar, Bile, Fibrin and red particles, Pus.

1. Water forms by far the largest constituent of urine, every 1000 parts of urine contain about 920 or 930 of water, but the proportion is constantly varying, when in great excess, forming what is called *watery* urine; sometimes there is a deficiency of water, constituting that form of disease denominated *urinæ suppressio*.

2. Sulphuric Acid is the most abundant acid which the urine contains, and is readily detected by first adding nitrate of baryta, and then a portion of nitric acid to dissolve any other precipitate which might be formed.

3. Muriatic Acid.—The next acid in order of quan-

tity which the urine contains, is the muriatic acid, which is readily detected by adding nitrate of silver to urine, from which the phosphoric and sulphuric acids have been separated by nitrate of baryta.

4. Phosphoric Acid is a more important ingredient of urine than either of the two preceding, since in combination with lime and magnesia it constitutes a very large class of urinary calculi: it is readily detected by adding a solution of nitrate of baryta; phosphate and sulphate of baryta are precipitated; the mixed precipitate is then digested in dilute nitric acid, which dissolves the phosphate, and by filtration the sulphate of baryta is got rid of; the fluid which passes through, contains phosphate of baryta held in solution by nitric acid; when solution of ammonia is added, the nitric acid is neutralized, and phosphate of baryta is again precipitated.

5. Lithic Acid exists in urine combined with ammonia in a very small proportion; lithic acid is very soluble in alkalies, and insoluble in acids, hence when the urine is strongly acid, the absence of lithic acid may be inferred; on the other hand, when the urine is alkaline, lithic acid is mostly present. It is readily detected by adding muriatic acid to the urine, when, if any be present, a white precipitate is formed.

6. Lactic Acid is obtained by evaporating the urine to the consistence of syrup, and digesting in alcohol; the insoluble matter which remains is acid, and contains impure lactic acid.

7. Ammonia is readily detected by gently heating urine to which a little liquor potassæ has been added, ammoniacal gas is given off, which is readily detected, either by the smell, or by its fugitive action on turmeric paper: but two circumstances demand our attention here,

1. ammonia is generated by the spontaneous decomposition of urine; on this account, newly-voided urine ought always to be the subject of analysis: 2. and lastly, the urea which is always contained in urine, is converted at a boiling temperature into carbonate of ammonia, hence the urine and liquor potassæ ought not to be raised to the boiling point.

8. POTASSA is detected by adding per chloride of platinum to urine, after being greatly reduced by evaporation; an insoluble double chloride of potassium and platinum, of a yellow colour, is precipitated.

9. SODA can only be recognised by the crystalline structure of its salts, there being no precipitant for this alkali.

10. LIME, when in small quantities, is held in solution by the different acids, but if it be in excess, it then combines with the phosphoric acid to form that species of calculus called the *bone-earth* or phosphate-of-lime calculus: to detect it, acidulate the urine with acetic acid, which will prevent the precipitation of the magnesia, and then add oxalate of ammonia; if any lime be present, a white precipitate is immediately formed, which is distinguished by its insolubility in muriatic acid, and ready solubility in nitric acid, from which it is again precipitated on the addition of an alkali.

11. MAGNESIA is only contained in very small quantities in healthy urine, sometimes, however, it is secreted in excess, and then it combines with the phosphoric acid and ammonia to form another species of calculi, called the *ammoniaco-magnesian phosphate;* in those cases the urea is very abundant; "but," says Dr. Prout, "it exists in some peculiar and imperfect state by which it is rendered extremely prone to decomposition, and liable to

be converted into the carbonate of ammonia." This will easily account for the additional quantity of ammonia which must necessarily be present in urine to assist in the formation of the ammoniaco-magnesian deposit: magnesia is readily detected by taking the urine from which lime has been separated in the manner already mentioned, and which contains phosphate of magnesia combined with ammonia from the oxalate of ammonia, forming a double salt held in solution by the acetic acid; on the addition of ammonia the acetic acid is neutralized, and a white precipitate is formed, which is known to be the double phosphate of ammonia and magnesia by its ready solubility in acetic acid.

12. Urea is an animal substance which exists only in the urine, and because it contains so large a quantity of azote, is supposed by some to remove the excess of azote from the body. It is detected by pouring cautiously a portion of urine on to the surface of an equal quantity of nitric acid; if the quantity of urea be large, crystallization may commence immediately at the line of separation between the two fluids; if, however, the quantity be very small, crystallization may not occur for 24 or 48 hours; hence one may judge comparatively of the quantity of urea, by the length of time required for the formation of crystals.

13. Albumen.—Healthy urine contains a very small quantity of albumen, which is rendered evident by the appearance of small flocculi after the operation of boiling; in certain states of disease, such as dropsy, the urine contains a very large quantity of albumen, so that on the application of heat the urine in many cases becomes gelatinous.

14. Mucus.—Another constituent of healthy urine is

mucus, which may be seen floating about in the urine like a flocculent woolly cloud. When the urine contains much free acid, the great irritation which it excites in the bladder greatly increases the quantity of mucus.

15. The colouring matter of urine has not yet been obtained in a separate state.

16. Urine is stated to contain gelatine: if such be the case, a precipitate (tanno-gelatine) is formed on the addition of infusion of galls.

17. Nitric acid not unfrequently enters into the composition of diseased urine, but seldom, if ever, into the composition of healthy urine; abstractedly its importance is small, but be it recollected that its presence is essential to the formation of the lithic, and very probably also of the oxalic acids; which renders it a subject of greater interest.

18. In some diseases, such as dropsy, a pink deposition frequently occurs in the urine, which is principally composed of lithate of ammonia; its colour, however, principally depends on the presence of a peculiar acid, which is formed by the action of nitric acid on lithic acid, and whose salts always assume a deep purple colour, hence its name purpuric acid.

19. Oxalic Acid is never voided with the urine in a state of solution; it undoubtedly is secreted in that state by the kidneys; but since the urine generally contains lime, oxalate of lime must be formed, which is only soluble in nitric acid. The mode of recognising oxalate of lime will be treated of under the head of Calculi.

20. Carbonic Acid sometimes exists in urine. Its presence was denied by Berzelius for a time, but its occasional presence is now undeniably proved by the discovery of a class of calculi in which carbonate of lime is the

principal constituent. The presence of free carbonic acid in urine may be ascertained by placing two vessels, one containing urine and the other lime water, under the exhausted receiver of an air-pump; if any carbonic acid be present, the lime water will be rendered turbid.

21. Healthy urine never contains any of the saccharine principle; but sometimes, through derangement of the secreting organs, sugar may exist in urine in considerable quantities; this, with an increase in the secretion of urine, constitutes a disease which is called *Diabetes Mellitus*. In such cases the urine possesses the following characters:—1. High specific gravity. 2. A sweet taste if the quantity of sugar be not very small. 3. The colour is very pale. 4. and lastly. There is a diminished proportion of the natural constituents of urine.

The following Table, constructed by Dr. Henry, which shows the quantity of solid saccharine extract in a wine pint of diabeted urine of different specific gravities, is extremely useful to the medical practitioner; for if he ascertain its specific gravity, and the quantity voided daily, he can easily, on reference to the Table, ascertain the quantity of solid matter which the patient is losing per viam vesicæ daily.

Specific gravity compared with 1000 parts of Water at 60°.	Quantity of solid extract in a Wine pint.	Quantity of solid extract in a Wine pint, in			
	Grains.	oz.	drs.	sc.	grs.
1020	382.4	0	6	1	2
1021	401.6	0	6	2	1
1022	420.8	0	7	0	0
1023	440.0	0	7	1	0
1024	459.2	0	7	1	19
1025	478.4	0	7	2	18
1026	497.6	1	0	0	17
1027	516.8	1	0	1	16
1028	536.0	1	0	2	16
1029	555.2	1	1	0	15
1030	574.4	1	1	1	14
1031	593.6	1	1	2	13
1032	612.8	1	2	0	12
1033	632.0	1	2	1	12
1034	651.2	1	2	2	11
1035	670.4	1	3	0	10
1036	689.6	1	3	1	9
1037	708.8	1	3	2	8
1038	728.0	1	4	0	8
1039	747.2	1	4	1	7
1040	766.4	1	4	2	6
1041	785.6	1	5	0	5
1042	804.8	1	5	1	4
1043	824.0	1	5	2	3
1044	843.2	1	6	0	3
1045	862.4	1	6	1	2
1046	881.6	1	6	2	1
1047	900.8	1	7	0	0
1048	920.0	1	7	1	0
1049	939.2	1	7	1	19
1050	958.4	1	7	2	18

22. In jaundice the urine is very frequently high-coloured, owing to the presence of bile; its presence is detected by the addition of muriatic acid, which renders it green.

23. Fibrin and red particles sometimes occur in diseased urine, but they are at once detected by their obvious characters.

24. Pus is sometimes present in urine, and it is rather difficult to distinguish between it and mucus; both present peculiar appearances that do not readily admit of description, but which to the eye satisfactorily distinguish between the two.

Having enumerated the substances which are contained in the urine, and the method of detecting them, I will in the next place give the proportions of each constituent of healthy urine according to Berzelius; but it must be borne in mind that, since the proportions are constantly varying even in the same individual, the following Table can only be taken as an approximation; viz.

Water	933.00
Urea	30.10
Sulphate of Potassa	3.71
Sulphate of Soda	3.16
Phosphate of Soda	2.94
Phosphate of Ammonia	1.65
Muriate of Soda	4.45
Muriate of Ammonia	1.50
Free Lactic (Acetic) Acid Lactate of Ammonia Animal Matter soluble in Alcohol and accompanying the Lactates Animal Matter insoluble in Alcohol Urea, not separate from the above	17.14
Earthy Phosphates, with a trace of fluate of Lime	1.00
Uric (Lithic) Acid	1.00
Mucus of the Bladder	0.32
Silica	0.03
	1000.

CLASSIFICATION AND CHEMICAL CHARACTERS OF THE CALCULI.

These may be arranged into six families, or classes, according to the following Table:—

1st Class.	Lithic Acid..	1. Pure Lithic Acid. 2. Lithate of Ammonia.
2nd. —	Phosphoric Acid	1. Phosphate of Lime. 2. Triple Phosphate of Ammonia and Magnesia. 3. Fusible Calculus (a compound of the two preceding species).
3rd. —	Oxalic Acid	1. Oxalate of Lime.
4th. —	Carbonic Acid	1. Carbonate of Lime.
5th. —	Cystic Oxide.	
6th. —	Zanthic Oxide.	

And lastly, Dr. Marcet detected in his collection a calculus which closely resembled fibrin in its general characters, hence he called it the *Fibrinous Calculus*; but as far as I am aware this is a solitary example.

FIRST CLASS.—LITHIC ACID.

This class, as I have already mentioned, contains two species, both of which are frequently contained in the same stone, forming what is called a *compound* calculus; the chemical characters of the class are: 1. It dissolves in caustic potassa, giving off at the same time ammoniacal gas if any lithate of ammonia be present. 2. From its solution in caustic potassa lithic acid is again precipitated unchanged on the addition of an excess of muriatic acid. 3. It dissolves with effervescence in dilute nitric acid, and the solution on evaporation to dryness leaves a purple stain.

SECOND CLASS.—PHOSPHORIC ACID.

1st species, PHOSPHATE OF LIME.—This species is very

rare, but when it does occur it may be recognised by a peculiar scaly appearance, and chemically by readily dissolving in muriatic acid, from which it is again precipitated on the addition of an alkali, or by slowly evaporating the solution, crystals of phosphate of lime are deposited, which are nearly infusible before the blowpipe.

2nd species, TRIPLE PHOSPHATE OF AMMONIA AND MAGNESIA.—This species is of much more frequent occurrence than the preceding, and is recognised, 1. by difficult fusibility before the blowpipe; 2. by its ready solubility in acetic acid, from which, on the addition of ammonia, it is again deposited in a crystalline form; 3. by exhaling an ammoniacal odour when it is boiled in caustic potassa.

3rd species, FUSIBLE CALCULUS.—This species is a compound of the two preceding. It is loose and friable in its texture; readily fusible before the blowpipe into a white enamel, hence its name; it is soluble partly in acetic and partly in muriatic acids; and white precipitates are formed in both fluids on the addition of an alkali.

THIRD CLASS.—OXALIC ACID.

Of this class there is generally said to be two species; viz. the mulberry and hempseed calculi; but they differ only in appearance, and not in chemical composition; hence there is but one species, viz. the *oxalate of lime*, which is recognised by the following properties:—1. When boiled in a solution of carbonate of potassa, oxalate of potassa and carbonate of lime are formed. 2. On adding the solution thus obtained (previously acidulated with acetic acid to ensure the absence of carbonic acid) to one containing lime, a white precipitate is immediately formed, which is insoluble in dilute muriatic acid, but

readily soluble in nitric acid. 3. When a portion of the calculus, consisting of oxalate of lime, is heated to redness, it suffers entire decomposition and carbonate of lime results; if the heat be urged by the blowpipe, pure lime is the result, which is known by its action on turmeric paper.

FOURTH CLASS.—CARBONIC ACID.

Of this class there is but one species, viz. the *carbonate of lime*, which is readily recognised, 1st, by dissolving with effervescence in dilute muriatic acid; and 2nd, on the addition of oxalate of ammonia to the solution in muriatic acid, a white precipitate is produced, which is oxalate of lime.

The cystic and zanthic oxides are of very rare occurrence; on that account their properties are but little known.

C. THE SOLID PARTS OF ANIMALS.

COMPOSITION OF HUMAN BONES,

According to Berzelius.

Cartilage	32.17
Bloodvessels	1.13
Fluate of Lime	2.0
Phosphate of Lime	51.04
Carbonate of Lime	11.30
Phosphate of Magnesia	1.16
Soda, Muriate of Soda, Water, &c.	1.20
	100.

COMPOSITION OF WOOL,

According to Dr. Ure.

10 atoms of	Carbon	.. ..	60
4 —	Oxygen	.. ..	32
3 —	Hydrogen	.. ..	3
1 —	Azote	.. ..	14
1 atom of	Wool is	.. ..	109

COMPOSITION OF SILK,

According to Dr. Ure.

10 atoms of	Carbon	.. ..	60
5 —	Oxygen	.. ..	40
4 —	Hydrogen	.. ..	4
1 —	Azote	..	14
1 atom of Silk is		.. ..	118

COMPOSITION OF BRAIN,

According to Vauquelin.

Water	80.00
White fatty Matter ..	4.53
Red fatty Matter ..	0.70
Albumen	7.00
Osmazome	1.12
Phosphorus	1.50
Acids, Salts, Sulphur ..	5.15
	100.

FOURTH DIVISION.

THE MOST IMPORTANT SALTS.

	Atomic Wt.
Acetate of Ammonia (1 Ammon. = 17 + 1 Ac. = 51)	68
Cryst. 7 at. of Water = 63	131
Potassa (1 Pot. = 48 + 1 Ac. = 51)	99
Soda (1 Sod. = 32 + 1 Ac. = 51)	83
Cryst. 6 at. of Water = 54.....	137
Lime (1 Lime = 28 + 1 Ac. = 51).....	79
Magnesia (1 Magn. = 20 + 1 Ac. = 51)	71

	Atomic Wt.
Acetate of Baryta (1 Bar. = 78 + 1 Ac. = 51)	129
Cryst. 3 at. of Water = 27	156
Strontia (1 Stron. = 52 + 1 Ac. = 51)	103
Zinc (1 Ox. of Z. = 42 + 1 Ac. = 51)	93
Cadmium (1 Ox. of Cad. = 64 + 1 Ac. = 51)	115
Cryst. 2 at. of Water = 18	133
Copper { (B. in Acetate) (1 Ox. of Cop. = 80 + 2 Ac. = 102) } ..	182
Cryst. 3 at. of Water = 27	209
Neutral (1 Ox. of Cop. = 80 + 1 Ac. = 51)	131
Cryst. 6 at. of Water = 54.....	185
Sub-Acetate (2 Ox. Cop. = 160 + 1 Ac. = 51)	211
Lead (1 Ox. of L. = 112 + 1 Ac. = 51)	163
Cryst. 3 at. of Water = 27	190
Bi-Acetate (2 Ox. of L. = 224 + 1 Ac. = 51)	275
Tri-Acetate (3 Ox. L. = 336 + 1 Ac. = 51)	387
Mercury (1 Protox. of Mer. = 208 + 1 Ac. = 51)	259
Silver (1 Ox. of Sil. = 118 + 1 Ac. = 51)	169
Arseniate of Lead (1 Ox. of L. = 112 + 1 Ars. Ac. = 62) ..	174
Lime (1 Lime = 28 + 1 Ars. Ac. = 62)	90
Magnesia (1 Magn. = 20 + 1 Ars. Ac. = 62) ..	82
Potassa (1 Pot. = 48 + 1 Ars. Ac. = 62)	110
Soda (1 So. = 32 + 1 Ars. Ac. = 62).....	94
Strontia (1 Stron. = 52 + 1 Ars. Ac. = 62)	114
Silver (3 Ox. of Sil. = 348 + 2 Ars. Ac. = 124)	472
Bin-Arseniate of Potassa (1 Pot. = 48 + 2 Ars. Ac. = 124)..	172
Cryst. 2 at. of Water = 18.....	190
Soda (1 Sod. = 32 + 2 Ars. Ac. = 124).....	156
Cryst. 12½ at. of Water = 112. 5.....	268
Arsenite of Potassa (1 Pot. = 48 + 1 Ars. Ac. = 54).....	102
Soda (1 Sod. = 32 + 1 Ars. Ac. 54)	86
Lime (1 Lime = 28 + 1 Ars. Ac. = 54)	82
Silver (1 Ox. of Sil. = 118 + 1 Ars. Ac. = 54) ..	172
Copper (1 Ox. of Cop. = 80 + 1 Ars. Ac. = 54)	134
Carbonate of Ammonia (1 Ammon. = 17 + 1 Carb. Ac. = 22)	39
Sesqui-Carbonate of Ammonia (2 Am. = 34 + 3 C. Ac. = 66)	100
Cryst. 2 at. of Water = 18..	118

	Atomic Wt.
Bi-Carbonate of Ammonia (1 Am. = 17 + 2 C. Ac. = 44) ..	61
Cryst. 1 at. of Water = 9.....	70
Carbonate of Baryta (1 Baryt. = 78 + 1 C. Ac. = 22)	100
Copper (1 Ox. of Cop. = 80 + 1 C. Ac. = 22)..	102
Iron (1 Protox. of Iron = 36 + 1 C. Ac. = 22)..	58
Lead (1 Protox. of Lead = 112 + 1 C. Ac = 22)	134
Lime (1 Lime = 28 + 1 C. Ac. = 22)	50
Magnesia (1 Mag. = 20 + 1 C. Ac. = 22).....	42
Manganese (1 Pro. Mang. = 36 + 1 C. Ac. = 22)	58
Strontia (1 Stron. = 52 + 1 C. Ac. = 22).....	74
Zinc (1 Ox. of Zinc = 42 + 1 C. Ac. = 22)	64
Soda (1 Soda = 32 + 1 C. A. = 22)	54
Cryst. 10 at. of Water = 90	144
Bi-Carbonate of Potassa (1 Pot. = 48 + 2 C. Ac. = 44)	92
Cryst. 1 at. of Water = 9.....	101
Soda (1 Soda = 32 + 2 C. Ac. = 44)	76
Cryst. 1 at. of Water = 9.....	85
Chlorate of Baryta (1 Baryt. = 78 + 1 Chl. Ac. = 76).....	154
Lead (1 Protox. of L. = 112 + 1 Chl. Ac. = 76)	188
Mercury (1 Prot. of M. = 208 + 1 Chl. Ac. = 76)	284
Potassa (1 Pot. = 48 + 1 Chl. Ac. = 76).....	124
Chromate of Potassa (1 Pot. = 48 + 1 Chr. Ac. = 52).....	100
Soda (1 Soda = 32 + 1 Chr. Ac. = 52).....	84
Ammonia (1 Am. = 17 + 1 Chr. Ac. = 52)....	69
Lime (1 Lime = 28 + 1 Chr. Ac. = 52)	80
Baryta (1 Baryta = 78 + 1 Chr. Ac. = 52)....	130
Lead (1 Protox. of L. = 112 + 1 Chr. Ac. = 52)	164
Mercury (1 Protox. of Mercury = 208 + 1 Chr. Ac. = 52)	260
Bi-Chromate of Potassa (1 Pot. = 48 + 2 Chr. Ac. = 104) ..	152
Muriate of Ammonia (1 Am. = 17 + 1 M. Ac. = 37).....	54
Baryta (1 Baryta = 78 + 1 M. Ac. = 37).....	115
Cryst. 1 at. of Water = 9	124
Lime (1 Lime = 28 + 1 M. Ac. = 37)	65
Cryst. 6 at. of Water = 54	119
Magnesia (1 Magn. = 20 + 1 M. Ac. = 37)	57

	Atomic Wt.
Muriate of Strontia (1 Stron. = 52 + M. Ac. = 37)	89
Cryst. 8 at. of Water = 72	161
Nitrate of Ammonia (1 Am. = 17 + 1 N. Ac. = 54)	71
Bismuth (1 Ox. of Bism. = 80 + 1 N. Ac. = 54)..	134
Cryst. 3 at. of Water = 27.....	161
Baryta (1 Bar. = 78 + 1 N. Ac. = 54)	132
Lead (1 Protox. of L. = 112 + 1 N. Ac. = 54)....	166
Lime (1 Lime = 28 + 1 N. Ac. = 54)	82
Magnesia (1 Mag. = 20 + 1 N. Ac. = 54)	74
Potassa (1 Pot. = 48 + 1 N. Ac. = 54).....	102
Silver (1 Ox. of Sil. = 118 + 1 N. Ac. = 54)	172
Soda (1 Soda = 32 + 1 N. Ac. = 54).....	86
Strontia (1 Stron. = 52 + 1 N. Ac. = 54).....	106
Proto-Nitrate of Mercury (1 Pro. of M. = 208 + 1 N. Ac. = 54)	262
Cryst. 2 at. of Water = 18	280
Per-Nitrate of Mercury (1 Per. of M. = 216 + 1 N. Ac. = 54)	270
Oxalate of Ammonia (1 Amm. = 17 + 1 Ox. Ac. = 36)	53
Cryst. 2 at. of Water = 18.....	71
Baryta (1 Bar. = 78 + 1 Ox. Ac. = 36).....	114
Cobalt (1 Ox. of Cob. = 38 + 1 Ox. Ac. = 36) ..	74
Lime (1 Lime = 28 + 1 Ox. Ac. = 36).....	64
Nickel (1 Prot. of Nick. = 34 + 1 Ox. Ac. = 36)	70
Potassa (1 Pot. = 48 + 1 Ox. Ac. = 36)	84
Cryst. 1 at. of Water = 9	93
Strontia (1 Stron. = 52 + 1 Ox. Ac. = 36)	88
Bin-Oxalate of Potassa (1 Pot. = 48 + 2 Ox. Ac. = 72)	120
Cryst. 2 at. of Water = 18	138
Quadroxalate of Potassa (1 Pot. = 48 + 4 Ox. Ac. = 144) ..	192
Cryst. 7 at. of Water = 63.....	255
Bin-Oxalate of Baryta (1 Bar. = 78 + 2 Ox. Ac. = 72)	150
Strontia (1 Stron. = 52 + 2 Ox. Ac. = 72) ..	124
Phosphate of Ammonia (1 Ammon. = 17 + 1 Phos. Ac. = 28)	45
Cryst. 2 at. of Water = 18	63
Soda (1 Sod. = 32 + 1 Phos. Ac. = 28)	60
Cryst. 12½ at. of Water = 112.5	172.5

	Atomic Wt.
Phosphate of Potassa (1 Pot.=48+1 Phos. Ac.=28)....	76
Soda and Ammonia (1 Am.=17, and 1 Pot.= 48+2 Phos. Ac.=56)	121
Cryst. 10 at. of Water=90	211
Silver (3 Ox. of Sil.=348+2 Phos. Ac.=56)	404
Lime (1 Lime=28+1 Phos. Ac.=28)	56
Bi-Phosphate of Potassa (1 Pot.=48+2 Phos. Ac.=56)..	104
Cryst. 2 at. of Water=18	122
Soda (1 Sod.=32+2 Phos. Ac.=56) ..	88
Ammonia (1 Am.=17+2 Phos. Ac.=56)	73
Cryst. 3 at. of Water=27	100
Lime (1 Lime=28+2 Phos. Ac.=56) ..	84
Sulphate of Alumina (1 Alum.=18+1½ S. Ac.=60).....	78
Ammonia (1 Am.=17+1 S. Ac.=40).....	57
Cryst. 2 at. of Water=18.....	75
Baryta (1 Bar.=78+1 S. Ac.=40).....	118
Copper (1 Perox. of Cop.=80+2 S. Ac.=80)	160
Cryst. 5 at. of Water=45.....	205
Iron (1 Protox. of Ir.=36+1 S. Ac.=40)....	76
Cryst. 6 at. of Water=54	130
Lead (1 Protox. of L.=112+1 S. Ac.=40) ..	152
Lime (1 Lime=28+1 S. Ac.=40)	68
Cryst. 2 at. of Water=18.....	86
Lithia (1 Lithia=18+1 S. Ac.=40)	58
Magnesia (1 Mag.=20+1 S. Ac.=40)	60
Cryst. 7 at. of Water=63	123
Proto-Sulphate of Mercury (1 Protox. of M. = 208 + 1 S. Ac. = 40)	248
Bi-Per-Sulphate of Mercury (1 Perox. of M. = 216 + 2 S. Ac. = 80).....	296
Sulphate of Potassa (1 Pot.=48+1 S. Ac.=40)	88
Bi-Sulphate of Potassa (1 Pot.=48+2 S. Ac.=80).....	128
Cryst. 2 at. of Water=18.....	136
Sulphate of Soda (1 Sod.=32+1 S. Ac.=40).....	72
Cryst. 10 at. of Water=90	162
Strontia (1 Stron.=52+1 S. Ac.=40).....	92

	Atomic Wt.
Sulphate of Zinc (1 Ox. of Z. = 42 + 1 S. Ac. = 40)	82
Cryst. 7 at. of Water = 63	145
Sulphate of Alumina and Potassa (1 Pot. = 48 and 2 Alumina = 54 + 4 S. Ac. = 160).....	262
Cryst. 25 at. of Water = 225	487
Tartrate of Lead (1 Protox. of L. = 112 + 1 T. Ac. = 66) ..	178
Lime (1 Lime = 28 + 1 T. Ac. = 66)	94
Potassa (1 Pot. = 48 + 1 T. Ac. = 66)	114
Bi-Tartrate of Potassa (1 Pot. = 48 + 2 T. A. = 132).....	180
Cryst. 1 at. of Water = 189	
Tartrate of Antimony and Potash (1 Pot. = 48 and 3 Protox. of Ant. 156 + 2 T. Ac. = 132).....	336
Cryst. 2 at. of Water = 18	352

TABLE OF CHEMICAL EQUIVALENTS,

ACCORDING TO BERZELIUS, HYDROGEN BEING TAKEN AS UNITY.

(Turner's Elements of Chemistry.)

EQUIVALENTS OF ELEMENTARY BODIES.

Elements.	Equivalents.	Symbols.
Aluminum	13.7	Al.
Antimony	64.6	Sb.
Arsenic	37.7	As.
Barium	68.7	Ba.
Bismuth	71.	Bi.
Boron	8.	B.
Bromine	78.26	Br.
Cadmium	55.8	Cd.
Calcium	20.5	Ca.
Carbon	6.	C.
Cerium	46.	Ce.
Chlorine	35.45	Cl.
Chromium	28.	Cr.
Cobalt	29.5	Co.
Columbium	185.	Cb.
Copper	31.6	Cu.
Fluorine	18.68	F.
Glucinium	17.7	G.
Gold	200.	Au.
Hydrogen	1.	H.
Iodine	126.	I.
Iridium	98.6	Ir.
Iron	28.	Fe
Lead	103.5	Pb.

continued.

EQUIVALENTS OF ELEMENTARY BODIES.

(*Continued.*)

Elements.	Equivalents.	Symbols.
Lithium	10.	L.
Magnesium	12.7	Mg.
Manganese	27.7	Mn.
Mercury	200.	Hg.
Molybdenum	47.7	Mo.
Nickel	29.5	Ni.
Nitrogen	14.	N.
Oxygen	8.	O.
Palladium	53.	Pd.
Phosphorus	15.7	P.
Platinum	98.6	Pt.
Potassium	39.15	Po.
Rhodium	52.	R.
Selenium	40.	Se.
Silicium	7.5	Si.
Silver	108.	Ag.
Sodium	23.3	So.
Strontium	43.8	Sr.
Sulphur	16.	S.
Tellurium	32.2	Te.
Thorium	59.6	Th.
Tin	57.9	St.
Titanium	24.3	Ti.
Tungsten	99.7	Tu.
Vanadium	68.5	V.
Uranium	217.	U.
Yttrium	32.2	Y.
Zinc	32.5	Zn.
Zirconium	30.	Z.

EQUIVALENTS OF COMPOUND BODIES.

C Signifies Crystallized.

aq Water, and the numeral before it indicates the number of equivalents of water which the crystals contain.

Acid, Acetic, 4 C + 3 H + 3 O ..	51.
C 1 aq	60.
Antimonious, Sb + 2 O ..	80.6
Antimonic, Sb + 2½ O	84.6
Arsen, As. + 2½ O	57.7
Arsenious, As + 1½ O	49.7
Benzoic, 15 C + 6 H + 3 O	120.
Boracic, B + 2 O.....	24.
C 2 aq	42.
Chloric, Cl + 5O	75.45
Chloro-Carbonic (C + O) + Cl.....	49.45
Chromic, Cr + 3 O	52.
Citric, 4 C + 2 H + 4 O..	58.
C 2 aq	76.
Columbic, Cb + 3 O	209.
Cyanic (2 C + N) + O ..	34.
Cyanuric, 1½ (2 C + N) + 3 O + 1½ H	64.5
Fluo-Boric, B + 3 F	64.04
Hydro-Fluoric H + F	19.68
Formic, 2 (C + O) + (H + O)	37.
Fluo-Silicic, Si + Fl	26.18
Hydriodic, H + I.....	127.
Hydro-Bromic, H + B ..	79.26
Hydro-Cyanic, H + (2 C + N)	27.
Hydro-Sulphuric, H + S..	17.
Hydro-Selenic, H + Se ..	41.
Hypo-Sulphurous, 2 S + 2 O	48.
Hypo-Sulphuric, 2 S + 5 O	72.
Iodic, I + 5 O	166.
Malic, 4 C + 1 H + 4 O ..	57.
Manganic, Mn + 3 O	51.7
Molybdic, Mo + 3 O	71.7
Muriatic, H + Cl.....	36.45
Nitric, N + 5 O	54.
Liquid, with 2 aq (sp. gr. 1.5).....	72.
Nitrous, N + 4 O	46.

Acid, Oxalic, 2 C + 3 O	36.
C 3 aq	63.
Per-Chloric, Cl + 7 O	91.45
Per-Manganic, 2 Mn + 7 O	111.4
Phosphorous, P + 1½ O ..	27.7
Phosphoric, P + 2½ O	35.7
Pyro-Gallic.....	63. ?
Selenious, Se + 16 O	56.
Selenic, Se + 24 O	64.
Succinic, 4 C + 2 H + 3 O	50.
Sulphuric, S + 3 O	40.
Liquid, 1 aq (sp. gr. 1.8485).....	49.
Sulphurous, S + 2 O	32.
Tartaric, 4 C + 2 H + 5 O	66.
C 1 aq	75.
Titanic, Ti + 2 O	40.3
Tungstic, Tu + 3 O.....	123.7
Uric, 6 C + 2 N + 1 O....	72.
C 2 aq	90.
Alcohol, (2 H + 2 C) + (H + O)	23.
Alumina, Al + 1½ O.....	25.7
Antimony	64.6
Sesqui-Chloride, Sb + 1½ Cl	100.05
Oxide, Sb + 1½ O	76.6
Sesqui-Sulphuret, Sb + 1½ S	88.6
Bi-Sulphuret, Sb + 2 S ..	96.6
Per-Sulphuret, Sb + 2½ S	104.6
Arsenic	37.7
Sulphuret (realgar), As + S	53.7
Sesqui-Sulphuret, As + 1½ S	61.7
Per-Sulphuret, As + 2½ S	77.7
Barium	68.7
Chloride, Ba + Cl	104.15
Oxide (baryta), Ba + O..	76.7
Barium Peroxide, Ba + 2 O	84.7
Sulphuret, Ba + S	84.7
Bismuth	71.
Chloride, Bi + Cl	106.45
Oxide, Bi + O	79.
Sulphuret, Bi + S	88.
Cadmium.....	55.8
Chloride, Cd + Cl	91.25
Oxide, Cd + O	63.8
Sulphuret, Cd + S	71.8
Calcium	20.5
Chloride, Ca + Cl	55.95

Calcium, Oxide (lime), Ca + O	28.5
Sulphuret, Ca + S	36.5
Phosphuret, Ca + P	36.2
Carbon	6.
Chloride C + Cl	41.45
Per-Chloride, 2 C + 3 Cl	106.35
Oxide, C + O	14.
Bi-Sulphuret, C + 2 S	38.
Cerium	46.
Oxide, Ce + O	54.
Peroxide, Ce + 1½ O	58.
Chloral, 9 C + 6 Cl + 4 O	298.70
Chlorine	35.45
Oxide? Cl + O	43.45
Peroxide, Cl + 4 O	67.45
Chromium	28.
Chloride, Cr + 1½ Cl	45.72
Ter-Chloride, Cr + 3 Cl	134.35
Ter-Fluoride, Cr + 3 F	84.04
Oxide, Cr + 1½ O	40.
Cobalt	29.5
Chloride, Co + Cl	69.95
Oxide, Co + O	37.5
Peroxide, Co + 1½ O	41.5
Sulphuret, Co + S	45.5
Copper	31.6
Di-Chloride, 2 Cu + Cl	98.65
Chloride, Cu + Cl	66.05
Di-Oxide, 2 Cu + O	71.2
Oxide (black), Cu + O	39.6
Di-Sulphuret, 2 Cu + S	79.2
Sulphuret, Cu + S	47.6
Cyanogen, 2 C + N	26.
Ether, 2 (2 C + 2 H) + (H + O)	37.
Glucina, G + O	25.7
Gold	200.
Chloride, Au + Cl	235.45
Ter-Chloride, Au + 3 Cl	306.35
Oxide, Au + O	208.
Ter-Oxide, Au + 3 O	224.
Ter-Sulphuret, Au + 3 S	248.
Hydrogen	1.
Arseniuretted, As + H	38.7
Carburetted (light), C + 2 H	8.
Carburetted (heavy), 2 C + 2 H	14.
Iron	28.
Chloride, Fe + Cl	63.45

Iron, Per-Chloride, Fe + 1½ Cl..	80.7
Oxide, Fe + O.....	36.
Peroxide, Fe + 1½ O	40.
Sulphuret, Fe + S	44.
Bi-Sulphuret, Fe + 2 S ..	60.
Lead	103.5
Chloride, Pb + Cl	138.95
Iodide, Pb + I.....	229.5
Oxide, Pb + O	111.5
Sesqui-Oxide, Pb + 1½ O	115.5
Peroxide, Pb + 2 O	119.5
Sulphuret, Pb + S	119.5
Lithium	10.
Chloride, L + Cl.....	45.45
Oxide (lithia) L + O ..	18.
Sulphuret, L + S.....	26.
Magnesium.....	12.7
Chloride, Mg + Cl	48.15
Oxide, Mg + O	16.7
Manganese.....	27.7
Chloride, Mn + Cl	63.15
Per-Chloride, 2 Mn + 7 Cl	303.55
Oxide, Mn + O	35.7
Sesqui-Oxide, Mn + 1½ O	39.7
Bi-Oxide, Mn + 2 O	43.7
Red Oxide, 3 Mn + 4 O	115.1
Varvicite, 4 Mn + 7 O ..	166.8
Sulphuret, Mn + S	43.7
Mercury.....	200.
Chloride, Hg + Cl	235.45
Bi-Chloride, Hg + 2 Cl ..	270.9
Iodide, Hg + I.....	326.
Bin-Iodide, Hg + 2 I....	452.
Oxide, Hg + O	208.
Bin-Oxide, Hg + 2 O....	216.
Sulphuret, Hg + S	216.
Bi-Sulphuret, Hg + 2 S ..	232.
Molybdenum	47.7
Oxide, Mo + O	55.7
Bin-Oxide, Mo + 2 O....	63.7
Bi-Sulphuret, Mo + 2 S..	79.7
Ter-Sulphuret, Mo + 3 S	95.7
Nickel	29.5
Chloride, Ni + Cl	64.95
Oxide, Ni + O	37.5
Sesqui-Oxide, Ni + 1½ O	41.5
Sulphuret, Ni + S	45.5
Nitrogen.....	14.
Bi-Carburet, 2 C + N....	26.

Nitrogen, Chloride, N+4 Cl ..	155.8
Iodide, N+3 I	392.
Oxide, N+O	22.
Bin-Oxide, N+2 O	30.
Palladium	53.
Oxide, Pd+O	61.
Bin-Oxide, Pd+2 O....	69.
Phosphorus	15.7
Chloride, P+1½ Cl	68.87
Per-Chloride, P+2½ Cl	104.32
Platinum.....	98.6
Chloride, Pt+Cl	134.65
Bi-Chloride, Pt+2 Cl ..	169.5
Oxide, Pt+O.....	106.6
Bin-Oxide, Pt+2 O	114.6
Sulphuret, Pt+S	114.6
Potassium	39.15
Chloride, Po+Cl	74.6
Iodide, Po+I.....	165.15
Oxide (potash), Po+O..	47.15
Peroxide, Po+3 O	63.15
Sulphuret, Po+S	55.15
Rhodium.....	52.
Oxide, R+O	60.
Sesqui-Oxide, R+1½ O	64.
Silica, Si+O	15.5
Silver	108.
Chloride, Ag+Cl	143.45
Iodide, Ag+I.....	234.
Oxide, Ag+O	116.
Sulphuret, Ag+S	124.
Sodium	23.3
Chloride, So+Cl	58.75
Iodide, So+I	149.3
Oxide (soda), So+O....	31.3
Peroxide, So+1½ O	35.3
Sulphuret, So+S	39.3
Strontium	43.8
Chloride, Sr+Cl	79.25
Iodide, Sr+I	169.8
Oxide (strontia), Sr+O	51.8
Sulphuret, Sr+S	59.8
Sulphur	16.
Chloride	51.45
Sulphuretted Hydrogen.....	17.
Tellurium	32.2
Chloride, Te+Cl	67.35
Bi-Chloride, Te+2 Cl ..	103.1
Oxide, Te+O.....	40.2

Tin	57.9
Chloride, St + Cl	93.35
Bi-Chloride, St + 2 Cl	128.8
Oxide, St + O	65.9
Bin-Oxide, St + 2 O	73.9
Sulphuret, St + S	73.9
Bi-Sulphuret, St + 2 S	89.9
Titanium	24.3
Bi-Chloride, Ti + 2 Cl	59.85
Oxide, Ti + O	32.3
Bi-Sulphuret, Ti + 2 S	56.3
Titanic Acid, Ti + 2 O	40.3
Tungsten	99.7
Oxide, Tu + 2 O	115.7
Acid, Tu + 3 O	123.7
Vanadium	68.5
Bi-Chloride, V + 2 Cl	139.4
Ter-Chloride, V + 3 Cl	174.85
Oxide, V + O	76.5
Bin-Oxide, V + 2 O	84.5
Acid, V + 3 O	92.5
Bi-Sulphuret, V + 2 S	84.5
Ter-Sulphuret, V + 3 S	100.5
Uranium	217.
Oxide, U + O	225.
Peroxide, U + 1½ O	229.
Water, H + O	9.
Yttria, Y + O	40.2
Zinc	32.5
Chloride, Zn + Cl	67.95
Oxide, Zn + O	40.5
Sulphuret, Zn + S	48.5
Zinconia, Z + O	38.

SALTS.

ac is used as an abbreviation for the *acid* of a salt, when the symbol is complex.

Acetate of Ammonia (3 H + N), + ac	68.
C 7 aq	131.
Baryta, Ba + ac	127.7
C 3 aq	154.7
Cadmium, Ca + ac	114.8
C 2 aq	132.8

Acetate of Copper (neutral), Cu + ac ..	90.6
C 1 aq	99.6
Copper (di-acetate), 2 $\dot{C}u$ + ac + 6 aq	184.2
Copper (tri-acetate), 3 $\dot{C}u$ + ac + 1½ aq	183.3
Lead, Pb + ac.....	162.5
C 3 aq	189.5
Lead (di-acetate), 2 Pb + ac ..	274.
Lead (tri-acetate), 3 Pb + ac..	385.5
Lime, Ca + ac	79.5
Magnesia, $\dot{M}g$ + ac.....	69.7
Mercury, $\dot{H}g$ + ac	259.
Potassa, $\dot{P}o$ + ac.....	98.15
Silver, $\dot{A}g$ + ac	167.
Strontia, Sr + ac.....	102.8
Zinc, Zn + ac	91.5
C 7 aq.....	154.5
Arseniate of Lead, Pb + ac	169.2
Lime, Ca + ac.....	86.2
Potassa, Po + ac.....	104.85
Bin-Arseniate of Potassa, Po + 2 ac ..	162.55
C 2 aq	180.55
Arseniate of Soda, So + ac.....	89.
Bin-Arseniate of Soda, So + 2 ac	146.7
C 12½ aq	259.2
Arseniate of Silver, 3 $\dot{A}q$ + 2 ac	463.4
Carbonate of Baryta, $\dot{B}a$ + $\ddot{\dot{C}}$	98.7
Copper, $\dot{C}u$ + $\ddot{\dot{C}}$	61.6

Carbonate of Iron, $\dot{Fe}+\ddot{C}$	58.
Lead, $\dot{Pb}+\ddot{C}$	135.5
Lime, $\dot{Ca}+\ddot{C}$	50.5
Magnesia, $\dot{Mg}+\ddot{C}$	42.7
Manganese, $\dot{Mn}+\ddot{C}$	57.7
Potassa, $\dot{Po}+\ddot{C}$	69.15
Bi-Carbonate of Potassa, $\dot{Po}+2\ddot{C}$	91.15
C 1 aq	100.15
Carbonate of Soda, $\dot{So}+\ddot{C}$	53.3
C 10 aq	143.3
Bi-Carbonate of Soda, $\dot{Po}+2\ddot{C}$	65.3
C 1 aq	74.3
Carbonate of Strontia, $\dot{Sr}+\ddot{C}$	73.8
Zinc, $\dot{Zn}+\ddot{C}$	62.5
Chlorate of Baryta, $\dot{Ba}+\dddot{Cl}$	152.15
Lead, $\dot{Pb}+\dddot{Cl}$	186.95
Mercury, $\dot{Hg}+\dddot{Cl}$	283.45
Potassa, $\dot{Po}+\dddot{Cl}$	122.6
Chromate of Baryta, $\dot{Ba}+\dddot{Cr}$	128.7
Lead, $\dot{Pb}+\dddot{Cr}$	163.5
Mercury, $\dot{Hg}+\dddot{Cr}$	260.
Potassa, $\dot{Po}+\dddot{Cr}$	99.15
Bi-Chromate of Potassa, $\dot{Po}+2\dddot{Cr}$	151.15
Muriate of Ammonia (3 H + N), + ac	53.45
Baryta, $\dot{Ba}$ + ac	113.15
C 1 aq	122.15
Lime, $\dot{Ca}$ + ac	64.95
C 6 aq	118.95

Muriate of Magnesia, $\dot{M}g + ac$	57.15
Strontia, $\dot{S}r + ac + 8\ aq$	160.25
Nitrate of Ammonia $(3\ H + N), + \dot{N}$	71.
Baryta, $\dot{B}a + \dot{N}$	137.
Bismuth, $\dot{B}i + \dot{N}$	133.
C 3 aq	160.
Lead, $\dot{P}b + \dot{N}$	165.5
Lime, $\dot{C}a + \dot{N}$	82.5
Magnesia, $\dot{M}g + \dot{N}$	74.7
Mercury, $\dot{H}g + 2\ aq + \dot{N}$	280.
Potassa, $\dot{P}o + \dot{N}$	101.15
Silver, $\dot{A}g + \dot{N}$	170.
Soda, $\dot{S}o + \dot{N}$	85.3
Strontia, $\dot{S}r + \dot{N}$	105.8
Oxalate of Ammonia $(3\ H + N), + ac$	53.
C 2 aq	71.
Baryta, $\dot{B}a + ac$	112.7
Bin-Oxalate of Baryta, $\dot{B}a + 2\ ac$	148.7
Oxalate of Cobalt, $\dot{C}o + ac$	73.5
Lime, $\dot{C}a + ac$	64.5
Nickel, $\dot{N}i + ac$	73.5
Potassa, $\dot{P}o + ac$	83.15
C 1 aq	92.15
Bin-Oxalate of Potassa, $\dot{P}o + 2\ ac$	119.15
C 2 aq	137.15
Quadroxalate of Potassa, $\dot{P}o + 4\ ac$	191.15
C 7 aq	254.15
Oxalate of Strontia, $\dot{S}r + ac$	87.8

Phosphate of Ammonia (3 H + N), + ac	52.7
C 2 aq	77.
Baryta, $\dot{B}a$ + ac	112.4
Phosphate of Lead, $\dot{P}b$ + ac	147.2
Lime, $\dot{C}a$ + ac	64.2
Magnesia, $\dot{M}g$ + ac	55.4
Soda, $\dot{S}o$ + ac	67.
C 12½ aq	179.5
Sulphate of Alumina, ½ $(\ddot{\underline{Al}})$ + S	65.7
Ammonia (3 H + N), $\ddot{\dot{S}}$ + 1 aq	66.
Baryta, $\dot{B}a + \ddot{\dot{S}}$	116.7
Copper, $\dot{C}u + \ddot{\dot{S}}$	79.6
C 3 aq	124.6
Iron, $\dot{F}e + \ddot{\dot{S}}$	76.
C 6 aq	130.
Lead, $\dot{P}b + \ddot{\dot{S}}$	151.5
Lime, $\dot{C}a + \ddot{\dot{S}}$	68.5
C 2 aq	86.5
Lithia, $\dot{L} + \ddot{\dot{S}}$	58.
Magnesia, $\dot{M}g + \ddot{\dot{S}}$	60.7
C 7 aq	123.7
Mercury, $\dot{H}g + \ddot{\dot{S}}$	248.
Bi-per-Sulphate of Mercury, $\ddot{\dot{H}}g + 2\ddot{\dot{S}}$	296.
Sulphate of Potassa, $\dot{P}o + \ddot{\dot{S}}$	87.15
Bi-Sulphate of Potassa, $\dot{P}o + 2\ddot{\dot{S}}$	127.15
C 2 aq	145.15
Sulphate of Soda, $\dot{S}o + \ddot{\dot{S}}$	71.3
C 10 aq	161.7

Sulphate of Strontia, $\dot{S}r + \dddot{S}$	91.8
Zinc, $\dot{Z}n + S$	80.5
C 7 aq.....	143.5
Alumina and Potassa ($\underline{\dddot{A}l} + 3\,\ddot{S}$), + ($\dot{P}o$ + $\ddot{S}$).....	258.55
C 24 aq (alum)	474.55
Tartrate of Lead, $\dot{P}b$ + ac.....	177.5
Lime, $\dot{C}a$ + ac.....	94.6
Potassa, $\dot{P}o$ + ac.....	113 15
Bi-Tartrate of Potassa, $\dot{P}o$ + ac	179.15
C 1 aq (cream of tartar)	188.15
Tartrate of Antimony and Potassa ($\dot{P}o$ + ac), + ($\underline{\dddot{S}b}$ + ac)	332.35
C 2 aq (tartar emetic) ..	350.35

TABLE

Showing the Proportions in which several Gaseous Bodies combine by Volume.

BY DR. HENRY.

Chlorine, protoxide of, gas ..	1 Oxygen + 2 Chlorine.....	2½
Chlorine, peroxide of, gas ..	2 Oxygen + 1 Chlorine.....	2
Chloric acid, vapour.....	1½ Oxygen + 1 Chlorine	1
Iodic acid	1½ Oxygen + 1 Iodine	
Aqueous vapour, steam	2 Hydrogen + 1 Oxygen	2
Muriatic acid gas	1 Hydrogen + 1 Chlorine....	2
Hydriodic acid, gas.....	1 Hydrogen + 1 Iodine.....	2
Nitric acid, vapour	1 Nitrogen + 2½ Oxygen	1
Nitrous acid, vapour	1 Nitrogen + 2 Oxygen.....	1
Hypo-Nitrous, vapour.....	1 Nitrogen + 1½ Oxygen	1
Nitrous gas	1 Nitrogen + 1 Oxygen	2
Nitrous oxide, gas	1 Nitrogen + ½ Oxygen	1
Air, atmospheric	4 Nitrogen + 1 Oxygen	5
Carbonic oxide, gas.....	1 Vapour of carbon + ½ Oxygen	1
Carbonic acid, gas	1 Vapour of carbon + 1 Oxygen	1
Carbonic acid	1 Carbonic oxide + ½ Oxygen	1
Chloric ether, vapour	1 Olefiant gas + 1 Chlorine ..	
Sulphurous acid, gas.....	1 Sulphur + 1 Oxygen	1
Sulphuric acid, vapour.....	2 Sulphurous acid + 1 Oxygen	2
Ammonia	3 Hydrogen + 1 Nitrogen ..	2
Carbonate, sub, of Ammonia	1 Carb. acid + 2 Ammonia	(solid)
Ditto, of Ditto..	1 Ditto + 1 Ditto	do.
Carbonate, sesqui, of Ditto ..	1 Ditto + 1½ Ditto	do.
Muriate of Ditto	1 Muriatic acid + 1 Ditto	do.
Fluo-borate of Ditto.....	1 Fluo-boric acid + 1 Ditto	do.
Ditto, sub, of Ditto....	1 Ditto + 2 Ditto	do.
Olefiant gas	2 Carbon + 2 Hydrogen	1
Carburetted hydrogen, gas ..	2 Hydrogen + 1 Carbon	1
Sulphuretted hydrogen, gas	1 Sulphur + 1 Hydrogen	1
Phosphuretted hydrogen, gas	1½ Hydrogen + ½ Phosphorus	1
Bi-Phosphuretted ditto	1½ Ditto + ¾ Ditto	1
Cyanogen, gas	1 Nitrogen + 2 Carbon.....	1
Chloro-cyanic acid, vapour..	1 Cyanogen + 1 Chlorine	2
Hydro-cyanic acid, vapour ..	1 Cyanogen + 1 Hydrogen ..	2
Chloro-carbonic acid, gas....	1 Carbonic oxide + 1 Chlorine	1
Sulphuret of carbon, vapour	1 Carbon + 2 Sulphur	1
Alcohol, vapour.....	1 Olefiant gas + 1 aq. vapour	1
Ether, muriatic, vapour	1 Mur. acid, gas + 2 Alcohol	2
Ether, sulphurous, vapour ..	2 Olefiant gas + 1 aq. vapour	1

Sulphate of Strontia, $\dot{S}r+\bar{S}$	91.8
Zinc, $\dot{Z}n+\bar{S}$	80.5
C 7 aq	143.5
Alumina and Potassa $(\bar{\underline{Al}}+\bar{S}\bar{S})_3+(\dot{P}o$ $+\bar{S})$	258.55
C 24 aq (alum)	474.55
Tartrate of Lead, $\dot{P}b+ac$	177.5
Lime, $\dot{C}a+ac$	94.6
Potassa, $\dot{P}o+ac$	115 15
Bi-Tartrate of Potassa, $\dot{P}o+ac$	179.15
C 1 aq (cream of tartar)	188.15
Tartrate of Antimony and Potassa $(\dot{P}o$ $+ac)_2+(\bar{\underline{Sb}}+ac)$	332.35
C 2 aq (tartar emetic) ..	350.35

TABLE

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combine by

BY

rine, protoxide of, gas
rine, peroxide of, gas
ric acid, vapour
acid
ous vapour, steam
ate acid gas
riodic acid, gas
ic acid, vapour
ous acid, vapour
o-Nitrous, vapour
ous gas
ous oxide, gas
atmosphere
onic oxide, gas
onic acid, gas
onic acid
ric ether, vapour
lurous acid gas
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-boracic of
Nitric, sub. of
lant gas

Thomson
Klaproth
Wollaston
Gay
and

TABLE

OF THE SPECIFIC GRAVITIES OF GASES.

Barometer 30.—Thermometer 60.

Names of Gases.	Specific Gravity.	Weight of 100 cubic inches.	Authorities.
		Grains.	
Atmospheric Air.....	1.000	30.500	Shuckburgh
Oxygen	1.111	33.888	Thomson
Chlorine	2.500	76.250	Ditto
Iodine Vapour.....	8.611	262.630	Ditto
Hydrogen	0.069	2.116	Ditto
Nitrogen	0.972	29.652	Ditto
Carbon Vapour	0.416	12.608	Gay Lussac
Sulphur Ditto.....	1.111	33.888	Thomson
Phosphorous Ditto.....	0.833	25.416	Ditto
Ammonia.....	0.590	18.003	Ditto
Carburetted Hydrogen ..	0.555	16.944	Ditto
Olefiant Gas	0.972	29.652	Ditto
Phosphuretted Hydrogen	0.902	27.537	Ditto
Bi-Hydroguret of Phosp.	0.972	29.652	Ditto
Sulphuretted Hydrogen..	1.180	36.007	Ditto
Bi-Sulphuret of Carbon Va.	2.638	80.486	Ditto
Cyanogen.....	1.805	55.069	Gay Lussac
Aqueous Vapour.....	0.625	19.062	Ditto
Nitrous Oxide.....	1.527	46.597	Thomson
Nitric Oxide	1.041	31.770	Ditto
Carbonic Oxide	0.972	29.652	Ditto
Carbonic Acid.....	1.527	46.597	Ditto
Fluoboric.....	2.361	72.013	Ditto
Fluosilicic	3.611	110.138	Ditto
Hydriodic	4.340	132.378	Ditto
Hydro-Cyanic Vapour ..	0.937	28.527	Ditto
Hypo-Nitrous.....	2.638	80.465	Theory
Muriatic	1.284	39.183	Thomson
Nitrous Acid	3.194	97.426	Theory
Nitric	3.75	114.375	Sir H. Davy
Sulphurous	2.222	67.777	Thomson
Sulphuric Acid Vapour ..	2.777	84.698	Ditto

TABLE

OF THE SPECIFIC GRAVITY OF METALS,

At 60° Fahrenheit, compared to Water as unity.

Platinum.....	20.98	Brisson
Gold.....	19.25	Ditto
Tungsten.....	17.6	D'Elhuyart
Mercury.....	13.56	Brisson
Palladium	11.3 to 8	Wollaston
Lead	11.352	Brisson
Silver	10.474	Ditto
Bismuth	9.822	Ditto
Uranium.....	9.	Bucholz
Copper.....	8.895	Hatchett
Cadmium.....	8.604	Stromeyer
Cobalt.....	8.538	Haüy
Arsenic	5.8843	Turner
Nickel.....	8.279	Richter
Iron.....	7.788	Brisson
Molybdenum ..	7.400	Hielm
Tin.....	7.291	Brisson
Zinc.....	6.861 to 7.1	Ditto
Manganese	6.850	Bergmann
Antimony	6.702	Brisson
Tellurium	6.115	Klaproth
Titanium.....	5.3	Wollaston
Sodium	0.972	Gay Lussac
Potassium	0.865	and Thenard

TABLE

OF THE QUANTITY OF REAL AMMONIA IN SOLUTIONS OF DIFFERENT DENSITIES.

SIR H. DAVY.

100 Parts of Sp. gravity.	Contain of real Ammonia.	100 Parts of Sp. gravity.	Contain of real Ammonia.
.875	32.5	.943	14.53
.887	29.25	.947	13.46
.900	26.00	.951	12.40
.905	25.37	.954	11.56
.916	22.07	.957	10.82
.925	19.54	.959	10.17
.932	17.52	.961	9.60
.938	15.88	.969	9.50

TABLE

OF THE QUANTITY OF REAL ACID IN 100 PARTS OF LIQUID SULPHURIC ACID,

At the Temperature of 60° Fahrenheit.

MR. DALTON.

Atoms Acid Water.	Real Acid per cent. by Weight.	Real Acid per cent. by Measure.	Specific Gravity.	Boiling Point.
1+0	100	Unknown.	Unknown.	Unknown.
1+1	81	150	1.850	620°
	80	148	1.849	605°
	79	146	1.848	590°
	78	144	1.847	575°
	77	142	1.845	560°
	76	140	1.842	545°
	75	138	1.838	530°
	74	135	1.833	515°
	73	133	1.827	501°
	72	131	1.819	487°
	71	129	1.810	473°
	70	126	1.801	460°
	69	124	1.791	447°
1+2	68	121	1.780	435°
	67	118	1.769	422°
	66	116	1.757	410°
	65	113	1.744	400°
	64	111	1.730	391°
	63	108	1.715	382°
	62	105	1.699	374°
	61	103	1.684	367°
	60	100	1.670	360°
1+3	58.6	97	1.650	350°
	50	76	1.520	290°
	40	56	1.408	260°
1+10	30	39	1.30+	240°
1+17	20	24	1.200	224°
1+38	10	11	1.10−	218°

TABLE

OF THE COMPOSITION OF NITRIC ACID OF DIFFERENT DENSITIES.

Atoms of Acid.	Atoms of Water.	Acid in 100 Pts.	Specific Gravity.
1	1	85.714	1.55
1	2	75.000	1.485
1	3	66.668	1.454
1	4	60.000	1.423
1	5	54.545	1.392
1	6	50.000	1.369
1	7	46.260	1.345
1	8	42.857	1.322
1	9	40.000	1.303
1	10	37.500	1.284
1	11	35.294	1.265
1	12	32.574	1.249
1	13	31.579	1.233
1	14	30.000	1.217
1	15	28.571	1.201

TABLE

XHIBITING THE SPECIFIC GRAVITY OF MURIATIC ACID OF DETERMINATE STRENGTHS.

DR. THOMSON.

Atoms of Acid.	Atoms of Water.	Real Acid in 100 Pts. of the Liquid.	Specific Gravity.
1	6	40.659	1.203
1	7	37.000	1.179
1	8	33.945	1.162
1	9	31.346	1.149
1	10	29.134	1.139
1	11	27.206	1.1285
1	12	25.517	1.1197
1	13	24.026	1.1127
1	14	22.700	1.1060
1	15	21.512	1.1008
1	16	20.442	1.0960
1	17	19.474	1.0902
1	18	18.590	1.0860
1	19	17.790	1.0820
1	20	17.051	1.0780

RULES

FOR THE COMPARISON OF DIFFERENT THERMOMETER SCALES.

There are four thermometric scales in use; viz. Fahrenheit's, Reaumur's, Celsius's, and Delisle's.

Fahrenheit begins his scale 32 degrees below the freezing point of water, because he imagined that a mixture of snow and salt produced the greatest possible degree of cold; and hence the point to which a thermometer, when introduced to such a mixture, is called Zero. The freezing point of water is marked 32°, and the boiling point is marked 212°; the space between those two points being divided into 180 aliquot parts; Fahrenheit's scale is universally employed in this country and some parts of Germany.

Reaumur's, which is employed in France, is divided into 80 parts, the freezing and boiling points of water being 0° and 80° on his scale.

Celsius, whose scale is commonly in Sweden and other parts of the Continent, divides his scale into 100 parts between the freezing and boiling points of water.

Delisle, whose scale is used in Russia, divides the space between the boiling and freezing point of water into 150 parts; but unlike the others, makes the boiling point Zero, and the freezing point 150.

For measuring high degrees of temperature, instruments called Pyrometers are employed, the scale of which is divided into 240 parts; it commences at 1077° Fahrenheit, and every degree is equal to 130 degrees on Fahrenheit's scale

Rule 1. To reduce degrees on Fahrenheit's scale to corresponding ones on Reaumur's, multiply by 4 and divide by 9, first subtracting 32; thus,

	Fahrenheit.		Reaumur.
Example 1.	212° − 32 = 180 × 4 = 720 ÷ 9 =		80°
2.	50° − 32 = 18 × 4 =	72 ÷ 9 =	8°

Rule 2. By reversing the above, degrees on Reaumur's scale are thus reduced to those on Fahrenheit's; thus,

	Reaumur.		Fahrenheit.
Example 1.	80° × 9 = 720 ÷ 4 =	180 + 32 =	212°
2.	8° × 9 =	72 ÷ 4 = 18 + 32 =	50°

Rule 3. To reduce Fahrenheit's scale to Celsius's, first subtract 32, then multiply by 5 and divide by 9 in the following manner:—

	Fahrenheit.		Celsius.
Example 1.	212° − 32 = 180 × 5 =	900 ÷ 9 =	100°
2.	168° − 32 = 136 × 5 =	680 ÷ 9 =	75.5

Rule 4. To reduce Celsius's to Fahrenheit's, reverse the preceding rule; thus,

	Celsius.		Fahrenheit.
Example 1.	100° × 9 = 900 ÷ 5 =	180 + 32 =	212°
2.	75.5 × 9 = 680 ÷ 5 =	136 + 32 =	168°

Rule 5. To reduce Fahrenheit's scale to Delisle's, subtract 32, multiply by 5, divide by 6, and lastly, subtract the product from 150, the remainder will be the corresponding degree on Delisle's scale; thus,

	Fahrenheit.			Delisle.
Example 1.	196 − 32 = 164 × 5 =	820 ÷ 6 =	136.4	150.
				14.4

Rule 6. To reduce Delisle's to Fahrenheit's, first subtract it from 150, then multiply that product by 6, divide by 5, and add 32; thus,

Delisle.
150
Example 14.4

$135.4 \times 6 = 820 \div 5 = 164 + 32 = 196$

Rule 7. To reduce Fahrenheit's scale to Wedgewood's, divide by 130 and subtract 1077°.1.

Fahrenheit. Wedgewood.
Example 1. $10076 - 1077 = 8999 \div 130 = 68.\frac{20}{130}$
2. $21346 - 1077 = 19269 \div 130 = 148.\frac{29}{130}$

Rule 8. To reduce Wedgewood's scale to Fahrenheit's, multiply by 130, and add 1077; thus,

Wedgewood. Fahrenheit.
Example 1. $68\frac{20}{130} \times 130 = 8999 + 1077 = 10076°$
2. $148\frac{29}{130} \times 130 = 19267 + 1077 = 21346°$

The following TABLE will exhibit the three principal Thermometers, with the degrees corresponding with each, omitting Delisle's, being nearly obsolete.

Fahr.	Reaum.	Cent.	Fahr.	Reaum.	Cent.
212	80.	100.	173	62.6	78.3
211	79.5	99.4	172	62.2	77.7
210	79.1	98.8	171	61.7	77.2
209	78.6	98.3	170	61.3	76.6
208	78.2	97.7	169	60.8	76.1
207	77.7	97.2	168	60.4	75.5
206	77.3	96.6	167	60.	75.
205	76.8	96.1	166	59.5	74.4
204	76.4	95.5	165	59.1	73.8
203	76.	95.	164	58.6	73.3
202	75.5	94.4	163	58.2	72.7
201	75.1	93.8	162	57.7	72.2
200	74.6	93.3	161	57.3	71.6
199	74.2	92.7	160	56.8	71.1
198	73.7	92.2	159	56.4	70.5
197	73.3	91.6	158	56.	70.
196	72.8	91.1	157	55.5	69.4
195	72.4	90.5	156	55.1	68.8
194	72.	90.	155	54.6	68.3
193	71.5	89.4	154	54.2	67.7
192	71.1	88.8	153	53.7	67.2
191	70.6	88.3	152	53.3	66.6
190	70.2	87.7	151	52.8	66.1
189	69.7	87.2	150	52.4	65.5
188	69.3	86.6	149	52.	65.
187	68.8	86.1	148	51.5	64.4
186	68.4	85.5	147	51.1	63.8
185	68.	85.	146	50.6	63.3
184	67.5	84.4	145	50.2	62.7
183	67.1	83.8	144	49.7	62.2
182	66.6	83.3	143	49.3	61.6
181	66.2	82.7	142	48.8	61.1
180	65.7	82.2	141	48.4	60.5
179	65.3	81.6	140	48.	60.
178	64.8	81.1	139	47.5	59.4
177	64.4	80.5	138	47.1	58.8
176	64.	80.	137	46.6	58.3
175	63.5	79.4	136	46.2	57.7
174	63.1	78.8	135	45.7	57.2

TABLE of the three principal Thermometers, &c.—(*Continued.*)

Fahr.	Reaum.	Cent.	Fahr.	Reaum.	Cent.
134	45.3	56.6	92	26.6	33.3
133	44.8	56.1	91	26.2	32.7
132	44.4	55.5	90	25.7	32.2
131	44.	55.	89	25.3	31.6
130	43.5	54.4	88	24.8	31.1
129	43.1	53.8	87	24.4	30.5
128	42.6	53.3	86	24.	30.
127	42.2	52.7	85	23.5	29.4
126	41.7	52.2	84	23.1	28.8
125	41.3	51.6	83	22.6	28.3
124	40.8	51.1	82	22.2	27.7
123	40.4	50.5	81	21.7	27.2
122	40.	50.	80	21.3	26.6
121	39.5	49.4	79	20.8	26.1
120	39.1	48.8	78	20.4	25.5
119	38.6	48.3	77	20.	25.
118	38.2	47.7	76	19.5	24.4
117	37.7	47.2	75	19.1	23.8
116	37.3	46.6	74	18.6	23.3
115	36.8	46.1	73	18.2	22.7
114	36.4	45.5	72	17.7	22.2
113	36.	45.	71	17.3	21.6
112	35.5	44.4	70	16.8	21.1
111	35.1	43.8	69	16.4	20.5
110	34.6	43.3	68	16.	20.
109	34.2	42.7	67	15.5	19.4
108	33.7	42.2	66	15.1	18.8
107	33.3	41.6	65	14.6	18.3
106	32.8	41.1	64	14.2	17.7
105	32.4	40.5	63	13.7	17.2
104	32.	40.	62	13.3	16.6
103	31.5	39.4	61	12.8	16.1
102	31.1	38.8	60	12.4	15.5
101	30.6	38.3	59	12.	15.
100	30.2	37.7	58	11.5	14.4
99	29.7	37.2	57	11.1	13.8
98	29.3	36.6	56	10.6	13.3
97	28.8	36.1	55	10.2	12.7
96	28.4	35.5	54	9.7	12.2
95	28.	35.	53	9.3	11.6
94	27.5	34.4	52	8.8	11.1
93	27.1	33.8	51	8.4	10.5

TABLE of the three principal Thermometers, &c.—(*Continued.*)

Fahr.	Reaum.	Cent.	Fahr.	Reaum.	Cent.
50	8.	10.	12	8.8	11.1
49	7.5	9.4	11	9.3	11.6
48	7.1	8.8	10	9.7	12.2
47	6.6	8.3	9	10.2	12.7
46	6.2	7.7	8	10.6	13.3
45	5.7	7.2	7	11.1	13.8
44	5.3	6.6	6	11.5	14.4
43	4.8	6.1	5	12.	15.
42	4.4	5.5	4	12.4	15.5
41	4.	5.	3	12.8	16.1
40	3.5	4.4	2	13.3	16.6
39	3.1	3.8	1	13.7	17.2
38	2.6	3.3	0	14.2	17.7
37	2.2	2.7	1	14.6	18.3
36	1.7	2.2	2	15.1	18.8
35	1.3	1.6	3	15.5	19.4
34	0.8	1.1	4	16.	20.
33	0.4	0.5	5	16.4	20.5
32	0.	0.	6	16.8	21.1
31	0.4	0.5	7	17.3	21.6
30	0.8	1.1	8	17.7	22.2
29	0.3	1.6	9	18.2	22.7
28	1.7	2.2	10	18.6	23.3
27	2.2	2.7	11	19.1	23.8
26	2.6	3.3	12	19.5	24.4
25	3.1	3.8	13	20.	25.
24	3.5	4.4	14	20.4	25.5
23	4.	5.	15	20.8	26.1
22	4.4	5.5	16	21.3	26.6
21	4.8	6.1	17	21.7	27.2
20	5.3	6.6	18	22.2	27.7
19	5.7	7.2	19	22.6	28.3
18	6.2	7.7	20	23.1	28.8
17	6.6	8.3	21	23.5	29.4
16	7.1	8.8	22	24.	30.
15	7.5	9.4	23	24.4	30.5
14	8.	10.	24	24.8	31.1
13	8.4	10.5	25	25.3	31.6

TABLE of the three principal Thermometers, &c.—(*Continued.*)

Fahr.	Ream.	Cent.	Fahr.	Ream.	Cent.
26	25.7	32.2	34	29.3	36.6
27	26.2	32.7	35	29.7	37.2
28	26.6	33.3	36	30.2	37.7
29	27.1	33.8	37	30.6	38.3
30	27.5	34.4	38	31.1	38.8
31	28.	35.	39	31.5	39.4
32	28.4	35.5	40	32.	40.
33	28.8	36.1			

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